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***Psoroglaena halmaturina* sp. nov. (lichenised Ascomycota, Verrucariaceae) from Kangaroo Island, South Australia**

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Abstract

A new lichen species, *Psoroglaena halmaturina* P.M. McCarthy & Kantvilas (Verrucariaceae), is described from the bark of trees in remnant mallee and *Melaleuca* thicket on Kangaroo Island, South Australia. The generic affinities of the species are discussed and a key to the Australian species of *Psoroglaena*, and the related genera *Agonimia* and *Phylloblastia*, is provided.

Keywords: *Agonimia*, biodiversity, lichens, key, new species, *Phylloblastia*, taxonomy.

Introduction

The Verrucariaceae, one of the most species-rich families of lichenised fungi (including at least 700 taxa, with more than 80 currently known from Australia), is predominantly temperate in its geographical range, saxicolous in its substratum preference and is dominated by crustose taxa with a green photobiont, mainly black perithecioid ascomata, fissitunicate asci and a hamathecium of periphyses. While attempts to refine generic circumscriptions and resolve their relationships using molecular phylogenetic analyses (e.g. Gueidan *et al.* 2009; Muggia *et al.* 2010; Guzow-Krzemińska *et al.* 2012) have been informative, generic placement often remains problematic, as exemplified by our investigation of corticolous specimens recently collected on Kangaroo Island, South Australia.

These specimens have an inconspicuous, greenish, granulose to minutely squamulose thallus and blackish non-involucrellate ascomata that outwardly resemble the mainly northern-temperate to boreal genus *Agonimia* Zahlbr. However, all species of *Agonimia*, which is represented in Australia by *A. tristicula* (Nyl.) Zahlbr. and *A. opuntiella* (Buschardt & Poelt) Vězda, have ellipsoidal ascospores with muriform septation (McCarthy 2001a; Aptroot 2011). By contrast, the oblong-fusiform and persistently trans-septate ascospores of the South Australian material, in combination with other thalline and ascomatal characters, place it within the currently broad circumscription of *Psoroglaena* Müll.Arg.

Fourteen species of *Psoroglaena* occur mainly on the bark and leaves of trees (less commonly on rock and bryophytes) in temperate, subtropical and tropical regions of the world. They share the following combination of characters: 1) a filamentous, squamulose,

granulose or crustose thallus; 2) mycobiont hyphae that are usually papillose; 3) pale yellowish, pale brown, brownish grey or blackish perithecia that either lack or have a reduced involucrellum; and 4) colourless, transversely septate to muriform and fusiform-ellipsoidal to oblong-fusiform ascospores (Harada 2003; Lücking, 2008). The genus is already represented in Australia by the type species, the corticolous *P. cubensis* Müll.Arg., and the foliicolous *P. perminuta* (Vězda) H.Harada, both pale-fruited taxa known from eastern Queensland (McCarthy 2012). Furthermore, some species of *Phylloblastia* Vain., another mainly tropical and foliicolous genus, must be regarded as doubtfully distinct from *Psoroglaena* (McCarthy 2001b; Lücking 2008), being characterised by less-than-satisfactory attributes including comparatively subtle differences in the shape of perithecia and ascospores, and the presence or absence of an involucrellum.

Here, we describe *P. halmaturina*, a new species from Kangaroo Island, South Australia. It is characterised by its corticolous thallus, thalline morphology, the anatomy and dimensions of its blackish perithecia and the size and unique septation of the ascospores. In order to aid the recognition of this and similar taxa, we also provide a combined key to the three Australian species of *Psoroglaena*, the two *Agonimia* taxa, and the seven representatives of *Phylloblastia* (McCarthy 2010, McCarthy & Stajsic, in press).

***Psoroglaena halmaturina* P.M.McCarthy & Kantvilas, sp. nov.**

Thallus corticola, crustosus et irregulariter rugulosus vel granulosus aut minute squamulosus, pallide viridis vel medie griseoviridis, (30–) 50–70 (–100) µm crassus. Algae chlorococcoideae, 4–8 (–12) µm

diametro. Perithecia superficialiter admodum atra, plerumque late ovoidea vel pyriformes, semi-immersa aut prominantia et thallo partim tecto, (0.23–) 0.30 (–0.35) mm diametro. Involucrellum deest. Excipulum in sectione superne fuscoatrum, 40–55 μ m crassum, inferne bistratum, 22–30 μ m crassum. Paraphyses desunt. Periphyses ramosae-anastomosantes, 40–80 \times 1–1.5 μ m. Asci fissitunicati, ellipsoidei vel clavati, 70–85 \times 18–25 μ m. Ascospores incolratae, (5–) 7-septatae, oblongatae-fusiformes, (25–) 31 (–36) \times (5.5–) 7 (–9) μ m.

Mycobank no.: MB803954.

Holotypus: SOUTH AUSTRALIA. **Kangaroo Island:** Dudley East, Moffatt Road, alt. 70 m, on base of eucalypt trunk in remnant roadside strip of mallee, 30 Sep. 2011, G. Kantvilas 253/11 & B. de Villiers (HO 562831).

Thallus corticolous, crustose, diffuse and \pm smooth to minutely uneven and irregularly rugulose or granulose to minutely squamulose, dull pale green to medium greyish green, (30–) 50–70 (–100) μ m thick, ecorticate or the granules/squamules with an outer 'layer' of 1 or 2 periclinal hyphae; squamules rounded and 0.1–0.4 mm wide, or somewhat elongate and 0.2–0.5 mm long and 0.1–0.3 mm wide, lacking attachment organs, persistent or dissolving into \pm rounded granules 20–50 (–60) μ m wide. Photobiont cells green, unicellular, \pm spherical to broadly ellipsoidal, 4–8 (–12) μ m wide, occupying \pm the whole thallus or forming clusters of up to c. 100–200 cells; thalline hyphae short-celled, 1.5–2 μ m wide, sparingly papillose, the papillae conical or peg-like c. 1–1.5 μ m long and 0.5–1 μ m wide at the base. Prothallus not apparent. Ascomata perithecia, moderately numerous, solitary, scattered, (0.23–) 0.30 (–0.35) mm diam. [n = 50], outwardly dark olive-brown to dull blackish, initially subglobose and at least two-thirds

immersed in the thallus, becoming more prominent, broadly ovoid to broadly pyriform, occasionally short-rostrate below the rounded or somewhat flattened apex; even when prominent the lower half of the ascoma usually retaining a partial or complete thalline collar; ostiole inconspicuous or in a shallow depression 20–30 μ m wide. Involucrellum absent. Excipulum 40–55 μ m thick and uniformly dark at the apex, 22–30 μ m thick and bilayered below; inner layer hyaline to pale brown in thin section, the cells periclinally elongate, thin-walled and closely arranged; outer layer dark olive-brown, greyish black or jet-black, the cells more irregular in shape to \pm isodiametric, comparatively thick-walled. Subhymenium 10–15 μ m thick. Paraphyses absent. Periphyses branched and anastomosing, 40–80 \times 1–1.5 μ m. Ascoplasma IKI+ red-brown, unchanged after pretreatment with K; hymenial gel and subhymenium IKI–, turning blue-violet when pretreated with K. Asci fissitunicate, 8-spored, broadly ellipsoid or narrowly to broadly clavate, 70–85 \times 18–25 μ m [n = 30], initially with a distinct tholus and ocular chamber, the latter subsequently broadening and all but disappearing at maturity. Ascospores irregularly or obliquely massed in the ascus, colourless, transversely (5–) 7-septate, oblong-fusiform, straight or slightly curved, with subacute ends, not or only slightly constricted at the septa, (25–) 31 (–36) \times (5.5–) 7 (–9) μ m [n = 140]; wall c. 0.5–1 μ m thick, lacking an epispore; contents minutely granulose and/or guttulate. Pycnidia not seen. **Fig. 1.**

Notes. A broad suite of thalline and ascomatal characters place the new species in *Psoroglaena* while setting it apart from other taxa in that and related genera. Thus, *P. halmaturina* is characterised

Key to the Australian Species of *Psoroglaena*, *Agonimia* and *Phylloblastia*

- 1: Thallus growing on bark, soil or bryophytes
 - 2: Ascospores with (5–) 7 transverse septa only *Psoroglaena halmaturina*
 - 2: Ascospores muriform
 - 3: Ascomata pale orange-brown *Psoroglaena cubensis*
 - 3: Ascomata black
 - 4: Thallus growing on bark; ascospores 40–70 \times 20–30 μ m *Agonimia opuntiella*
 - 4: Thallus growing on soil or bryophytes; ascospores 60–135 \times 30–50 μ m *Agonimia tristicula*
- 1: Thallus growing on living leaves
 - 5: Ascospores submuriform
 - 6: Ascospores 32–52 \times 8–13 μ m, with 3–11 transverse septa *Phylloblastia bielczykiae*
 - 6: Ascospores 110–180 \times 5–10 μ m, with 40–70 transverse septa *Phylloblastia dolichospora*
 - 5: Ascospores with transverse septa only
 - 7: Thallus usually isidiate, often sterile *Phylloblastia borhidi*
 - 7: Thallus lacking isidia, commonly fertile
 - 8: Ascospores 3–6-septate
 - 9: Ascospores persistently 3-septate *Psoroglaena perminuta*
[possible syn: *Phylloblastia triseptata*]
 - 9: Ascospores (3–) 5 (–6)-septate *Phylloblastia blechnicola*
 - 8: Ascospores with 7 or more septa
 - 10: Ascospores 7-septate *Phylloblastia septemseptata*
 - 10: Ascospores (7–) 9–13 (–15)-septate
 - 11: Perithecia orange-brown; involucrellum absent; ascospores 4–6.5 μ m wide, with mucronate apices *Phylloblastia mucronata*
 - 11: Perithecia medium to dark olive-brown; involucrellum present; ascospores 6–12 μ m wide, non-mucronate *Phylloblastia excavata*

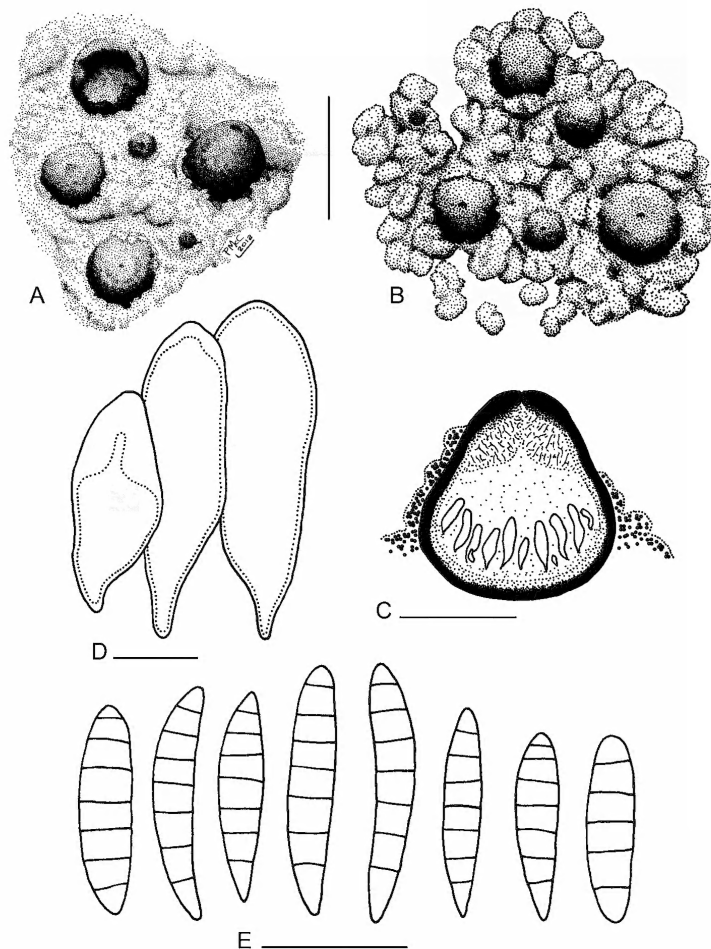


Fig. 1. *Psoroglaena halmaturina*. **A, B** habit of thalli and perithecia; **C** sectioned perithecium and adjacent thallus (semi-schematic); **D** (left to right) outline of immature, submature and mature asci; **E** mature ascospores. Scale bars: **A–B** 0.5 mm; **C** 0.2 mm; **D–E** 20 μ m. — **A, C–E** holotype; **B** Kantvilas 487/12 & de Villiers.

by its greenish, granulose to minutely squamulose corticolous thallus, dark, non-involucrellate perithecia that are eventually prominent (0.23–) 0.30 (–0.35) mm diam., and oblong-fusiform and predominantly 7-septate ascospores of $25\text{--}36 \times 5.5\text{--}9 \mu\text{m}$. The only other dark-fruited species of *Psoroglaena*, the leaf-inhabiting *P. laevigata* Lücking from Costa Rica, has discoid isidia, 0.15–0.25 mm diam. perithecia and 3–5-septate ascospores that are $20\text{--}28 \times 5\text{--}7 \mu\text{m}$ (Lücking 2008).

On the other hand, while *P. halmaturina* is superficially broadly similar to at least several of the 12 currently accepted species of *Agonimia*, its oblong-fusiform 7-septate ascospores distinguish it from the invariably ellipsoidal and muriform propagules of

Agonimia. Recent molecular analyses, or perhaps the species analysed (Muggia *et al.* 2010), have not resolved the relationship of *Psoroglaena* and *Agonimia*, nor do they address the complication of a possibly congeneric *Phylloblastia*. Clearly, as has been demonstrated for other pyrenocarpous lichen families such as the Pyrenulaceae (Harris 1973, 1995) and the Porinaceae (McCarthy & Malcolm 1997, as Trichotheliaceae), generic separation based solely or largely on ascospore septation (trans-septate vs muriform) is unsatisfactory. Indeed, if ascospore shape and septation are omitted from the generic diagnosis, then the Kangaroo Island lichen might just as easily be described as an *Agonimia*. However, given the current circumscriptions, that would be premature and certainly beyond the scope of this

contribution. Rather, *Psoroglaena* with its breadth of habitat and substratum preferences, as well as thalline and ascomatal morphology and anatomy is the most appropriate genus for what, regardless of its generic placement, is undoubtedly a hitherto undescribed species.

Distribution & habitat. *Psoroglaena halmaturina* is known only from two localities, both on Kangaroo Island, South Australia. Despite their relatively wide geographical separation (one is at the western extreme of the island, the other at the eastern), both sites fall within the 600 mm isohyet and can, therefore, be regarded as comparatively moist for the region as a whole.

At the type locality (Moffatt Road), *P. halmaturina* grew on thick, soft, fibrous bark at the base of a large eucalypt in a narrow, remnant band of mallee between a paddock and a road. Associated lichens included *Collema glaucophthalmum* var. *implicatum* (Nyl.) Degel., *Pannaria obscura* Müll.Arg. and an undescribed species of *Bacidia*. The depauperate condition of all the epiphytes suggested a heavily degraded habitat in severe decline. Its occurrence at the second locality (Ravine des Casoars) was equally tenuous. It grew on fibrous bark of young branches and twigs of *Melaleuca* in a narrow thicket 2–3 m tall fringing a creek. The habitat suggested a moist, sheltered environment, but incursion by a recent wildfire had destroyed all but a few ailing trees. Associated with the *Psoroglaena* were fragmentary thalli of *Pannaria obscura*, *Caloplaca kaernefeltii* S.Y.Kondr., Elix & A.Thell and *Rinodina australiensis* Müll.Arg. (all species typical of moist woodland), as well as *Opegrapha varia* Pers. sens. lat., an undescribed species of *Amandinea* M.Choisy ex Scheid. & H.Mayrhofer, *Physcia adscendens* (Fr.) H.Olivier and *P. rolandii* Elix.

Etymology. Derived from *Halmaturus*, a generic name once applied to kangaroos, and commonly used as an epithet for species from Kangaroo Island.

Additional specimen examined

SOUTH AUSTRALIA. Kangaroo Island: Ravine des Casoars, along riverbank, c. 0.5 km inland from the coast, alt. 15 m, on bark of remnant living *Melaleuca* in a badly burnt, degraded strip of *Melaleuca*-dominated woodland, 24 Sep. 2012, G. Kantvilas 487/12 & B. de Villiers (HO 567251).

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A new saxicolous species of *Catillaria* (lichenised Ascomycetes: Catillariaceae) from southern Australia

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Abstract

The new species *Catillaria austrolittoralis* Kantvilas & van den Boom is described from coastal rocks in southern Australia including Tasmania. It contains argopsin or pannarin, two compounds previously unreported for the genus.

Keywords: argopsin, biodiversity, lichens, pannarin, taxonomy.

Introduction

Catillaria A. Massal. is a genus of crustose lichens that is widely distributed throughout the world, not least in Australia, where the most recent checklist (McCarthy 2012) records 27 taxa. Traditionally the genus name was applied to crustose lichens with a green photobiont, apothecia with a well-developed margin lacking algal cells, mostly eight-spored asci, and colourless, 1-septate ascospores (Zahlbruckner 1927). Although this concept persists to some degree today, the study of additional characters in the latter part of the 20th Century, in particular of the ascus structure, led to a reappraisal and subdivision of many of Zahlbruckner's 'form genera' (other examples include *Lecidea* Ach. and *Bacidia* de Not.) and, as a result, the concept of *Catillaria* was refined considerably (Kilius 1981; Hafellner 1984).

Thus *Catillaria* in the strict sense is now defined as having a crustose thallus with a chlorococcoid photobiont, lecideine apothecia with a persistent margin, asci with a well-developed amyloid tholus that lacks any discernible internal structures (*Catillaria*-type of Hafellner 1984), paraphyses with capitate, pigmented apices, and hyaline, non-halonate, 1-septate ascospores. In Australia, many taxa continue to be included in *Catillaria* but, with further study, most will need to be placed elsewhere, potentially in unrelated genera such as *Megalania* Hafellner, *Cliostomum* Fr., *Toninia* A. Massal. or *Tylothallia* P. James & H. Kilius. The same applies even in regions where the lichen biota has been comparatively well-studied and where accounts of the genus include a heterogeneous assemblage of taxa whose precise generic affinities remain unresolved (e.g. Fletcher & Coppins 2009; Hertel et al. 2007).

In our review of many specimens of *Catillaria*-like lichens, as well as *Catillaria* names, we have encountered a species that, although rather common,

does not appear to have a name. We describe this lichen here as new to science.

Methods

The study is based chiefly on collections by the first author, housed mainly in the Tasmanian Herbarium (HO), and on selected collections from the Australian National Herbarium (CANB). Descriptions are based on hand-cut sections of the thallus and ascomata examined with high-power light microscopy. Mounting media included water, 15% KOH (K), Lugol's Iodine after pretreatment with K (IKI), ammoniacal erythrosin and 50% HNO₃ (N). Dimensions of asci and ascospores are based on 30 and 100 observations respectively. The latter are presented in the format: 5th percentile–average–95th percentile; outlying extreme values are given in parentheses. Routine chemical analyses using thin-layer chromatography (t.l.c.) follow standard methods (Orange et al. 2001); solvent A was the preferred medium.

Taxonomy

Catillaria austrolittoralis Kantvilas & van den Boom, *sp. nov.*

Thallo argopsinum vel pannarinum continenti, apotheciis lecideinis, pigmentosum aeruginosum destitutis, ascis tipo Catillariae pertinentibus et ascosporis uniseptatis, non halonatis, 7–13 µm longis, 3–5 µm latis distinguibilis.

Mycobank no.: MB803295.

Typus: SOUTH AUSTRALIA. **Kangaroo Island:** Stokes Bay, at beach NE of Stokes Bay Landing, 1 m alt., on sea-shore rocks, 19 Sep. 2012, G. Kantvilas 514/12 & B. de Villiers (holo.: HO; iso.: AD, BM, CANB, hb. van den Boom, MSC, UPS).

Thallus crustose, rimose-areolate in the centre, rather effuse towards the margins, pale to dull olive-brown to olive-grey, rarely pale grey, forming extensive patches

often 10–30 cm wide but frequently interrupted by other crustose lichens; individual areoles 0.1–0.35 mm wide, to c. 150 μm thick, irregularly angular, plane to rather convex or bullate, appressed or, at times, lifted away from the substratum; cortex absent; photobiont cells globose, 8–15 μm diam. *Apothecia* lecideine, sessile, basally constricted, 0.2–0.4 (–0.5) mm diam., scattered; disc black, matt, mostly plane, sometimes becoming convex in older apothecia; proper excipulum concolorous with the disc, inrolled when young, persistent, in section 8–20 (–30) μm thick, opaque dark brown, unchanged in K, N \pm orange-brown, annular and not continuous beneath the hypothecium, composed of compacted, cellular hyphae 3–7 μm wide. *Hypothecium* 25–60 (–80) μm thick, colourless to pale yellowish, interspersed with oil droplets. *Hymenium* 30–45 (–50) μm thick, colourless, separating readily in water and KOH, overlain by a dark brown epihymenium 6–8 μm thick composed of the uppermost, pigmented cells of the paraphyses; pigment K–, N–. *Asci* 8-spored, 25–35 (–40) \times (8–) 10–12 μm , clavate, of the *Catillaria*-type, with a prominent amyloid tholus lacking any internal differentiation, an apically truncate or concave ascoplasm and lacking an ocular chamber. *Paraphyses* simple or occasionally bifurcate at the apices, 1.5 (–2) μm thick; apices very markedly capitate, 4.5–6 (–7) μm wide, with an internally brown-pigmented apical cell. *Ascospores* (7–) 7.5–9.8–12.5 (–13) \times (3–) 3.5–4–4.5 (–5) μm , hyaline, thin-walled, non-halonate, 1-septate, ellipsoid, occasionally a little constricted at the septum. *Pycnidia* immersed, rather infrequent, resembling black apothecial initials. *Conidia* narrowly ellipsoid to fusiform, 2–3.5 \times 0.8–1 μm . **Fig. 1, 2A–C.**

Chemistry. Argopsin or pannarin detected by t.l.c.; the former tends to be the more common chemical race. The thallus is P+ orange in both cases.

Etymology. The specific epithet refers to the distribution of the species on the southern coast of Australia.

Remarks. The main characters of the new species, notably the lecideine apothecia, the *Catillaria*-type asci, the capitate paraphyses and the non-halonate, 1-septate ascospores, indicate unequivocally that it belongs to the genus *Catillaria* in the strict sense. However the presence of argopsin or pannarin makes the new species unique within *Catillaria* s.str. According to Kiliás (1981), in his detailed revision of the saxicolous *Catillaria* species in Europe, no lichen products are found in *Catillaria* species, and the same was observed by Fletcher & Coppins (2009) in their account of British species, and Hertel et al. (2007) for the Sonoran region. These chemical compounds may occur within the family Catillariaceae, but only in *Halecania* M. Mayrhofer (van den Boom 2009), a genus that is distinguished by its lecanorine apothecia and halonate ascospores (Mayrhofer 1987). Moreover, a dark brown proper excipulum is never observed in *Halecania*. In some *Halecania* species, for example *H. rhypodiza* (Nyl.)

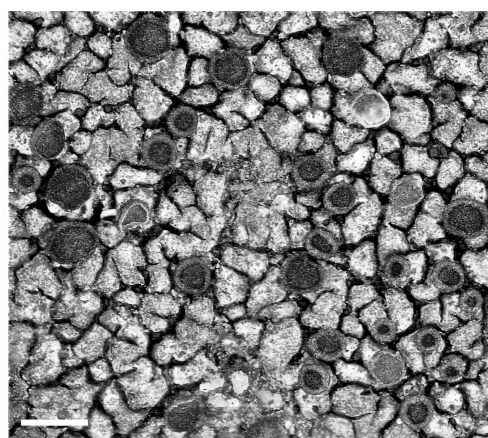


Fig. 1. *Catillaria australittoralis* (holotype): habit. Scale bar: 0.5 mm.

Coppins, the apothecia appear biatorine, but a thalline margin can often be observed in very young apothecia, or algal cells can be detected in the lower parts of the excipulum.

In the field, *C. australittoralis* resembles the chiefly Northern Hemisphere species, *C. chalybeia* (Borrer) A. Massal., in so far as both occur in the same habitats, have a dark, areolate thallus and similar apothecia, but the latter is distinguished by lacking chemical compounds, having a dark brown hypothecium, and typically having blue-green epithelial pigments. Also superficially similar is *C. subviridis* (Nyl.) Zahlbr., which also occurs in the supralittoral zone in the Northern Hemisphere, but that species has larger ascospores (10–16 \times 4.5–6 μm), smaller apothecia [0.1–0.2 (–0.3) mm] and lacks any chemical compounds (Fletcher & Coppins 2009).

Being so abundant, it would be reasonable to expect that this species would have been described previously. However, an examination of the protologues of possible taxa, and study of selected type specimens, particularly of taxa described in the 19th Century by J. Müller Argoviensis, has not revealed any older names.

The chemical variation in the species does not appear to be correlated to any morphological, anatomical or ecological characters. Indeed, both chemotypes have been found on the same rock types and at the same localities, and their distribution appears to be entirely random. One specimen (from Kangaroo Island) has no detectable chemistry, although it also lacks any discernible thallus and is from an unusual, slightly inland locality. Pannarin and argopsin are closely related β -orcinol depsidones, differing only by any additional chlorine atom in the latter (Huneck & Yoshimura 1996). Similar chemical variation can be observed in *Phyllopsora* species, such as *P. buettneri* (Müll. Arg.) Zahlbr. (Elix 2009).

Two *Catillaria* specimens from Western Australia (J.A. Elix 31710, 31713), collected at an altitude

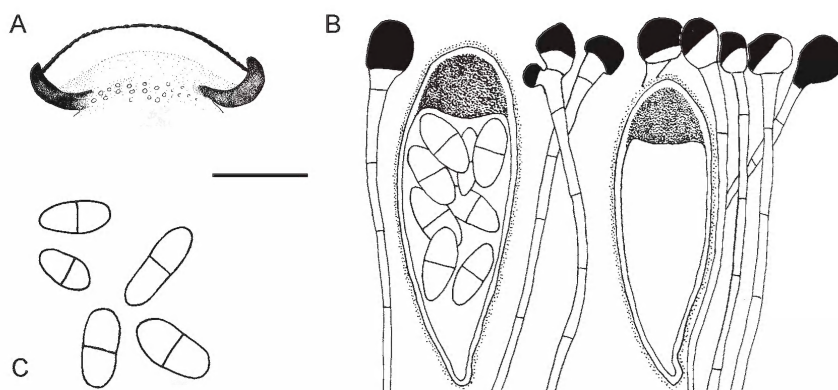


Fig. 2. *Catillaria austrolittoralis* (holotype): **A** vertical section of apothecium (schematic); **B–C** portion of hymenium and ascospores with amyloid tissues stippled. Scale bar: **A** 200 μ m, **B** 10 μ m.

of 365 m, are not included in our concept of *C. austrolittoralis* although they both contain argopsin and display many superficial similarities to the new species. They differ chiefly in having a thicker (to 100 μ m) hypothecium that is dark brown in the upper part, and narrower ascospores, (8.5–) 9–10–12 (12.5) \times 2.5–2.7–3 μ m; further collections are required to ascertain their status. There are additional collections of *Catillaria*-like lichens from Tasmania that likewise await further study.

The new species is very distinctive and generally easily recognized, even in the field. However, at certain locations it may occur together with *Amandinea devilliersiana* Elix & Kantvilas, which is superficially very similar but can be distinguished microscopically by its brown, 1-septate ascospores and by the presence of norstictic acid.

Ecology and distribution. *Catillaria austrolittoralis* is a common species of coastal rocks, where it is a typical component of the widespread southern Australian littoral lichen association dominated by *Tylothalia pahiensis* (Zahlbr.) Hertel & Kilius, species of *Caloplaca*, *Rinodina blastidiata* Matzer & H. Mayrhofer, *Ochrolechia* cf. *parella* (L.) A. Massal., *Flavoparmelia haysomii* (C. W. Dodge) Hale, *Xanthoparmelia conranensis* (Elix) Elix, *X. subprolixa* (Nyl. ex Kremp.) O. Blanco et al., *Xanthoria ligulata* (Körb.) P. James sens. lat. Less common associated species include *Rinodinella fertilis* (Körb.) Elix, *Buellia halonia* (Ach.) Tuck., *Amandinea coniops* (Wahlenb.) M. Choisy ex Scheid. & H. Mayrhofer, *A. devilliersiana* Elix & Kantvilas, *A. pelidna* (Ach.) Fryday & L. Arcadia [syn. *A. lecideina* (H. Mayrhofer & Poelt) Scheid. & H. Mayrhofer], *Buellia homophylla* (C. Knight) Zahlbr., *B. stellulata* (Taylor) Mudd, *Teloschistes spinosus* (Hook. f. & Taylor) J. S. Murray and numerous green *Xanthoparmelia* species. In this habitat, its dull, olive colour may be rather overshadowed by the bright white, orange and green of its associated taxa. Nevertheless, it tends to be quite common, and forms extensive colonies

and mosaics covering many tens of square centimetres. Although mainly collected along the seashore, this species can, rarely, occur away from the littoral zone. Thus it has been found on coastal pinnacles, even as high as 300 m elevation. It does not display any preferences for particular rock types, although it does not occur on limestone. However, Precambrian quartzite, Ordovician conglomerate, Devonian granite, Triassic sandstone and Jurassic dolerite are all colonised, although it appears to be particularly common on granite. The new species has hitherto been recorded from Tasmania, South Australia (Kangaroo Island), the Bass Strait islands, Victoria and southern New South Wales. However, its abundance at these localities and its tolerance of a wide range of rock types suggest it could occur more widely.

Specimens examined.

I. Argopsin chemotype:

SOUTH AUSTRALIA. Kangaroo Island: Point Ellen, 2 km S of Vivonne Bay, 4 m alt., 1985, J.A. Elix 19595 & L.H. Elix (CANB); Cape Willoughby, 2008, G. Kantvilas 331/08 (HO); Antechamber Bay, sea-level, 2008, G. Kantvilas 333/08 (HO); near King George Beach, 2 m alt., 2011, G. Kantvilas 328/11 (AD, hb. van den Boom, HO); Windmill Bay, 1 m alt., 2012, G. Kantvilas 493/12 (HO); Ravine des Casoars, 15 m alt., 2012, G. Kantvilas 479/12 & B. de Villiers (hb. van den Boom, HO).

TASMANIA. Penguin, 1968, W.A. Weber & D. McVean L-49694 (HO); Little Musselroe Bay, 4 m alt., 1983, A. Moscal 2963 (HO); Spring Beach, 1992, H. Mayrhofer 11257 & E. Hierzer (GZU, HO); Prosser River, sea-level, 1993, G. Kantvilas 40/93 (hb. van den Boom, HO); Whalers Lookout, Bichen, 50 m alt., 2000, G. Kantvilas 497/00 (HO); Low Head, 10 m alt., 2001, G. Kantvilas 969/01 (HO); Grants Point, 10 m alt., 2001, G. Kantvilas 211/01 (HO); Goat Island, 10 m alt., 2001, G. Kantvilas 1148/01 (HO); summit of Mt Murray, 315 m alt., 2006, G. Kantvilas 269/06 (HO); Spiky Beach, 2 m alt., 2011, G. Kantvilas 120/11 (HO); Cape Huay, 100 m alt., 2012, G. Kantvilas 306/12 (HO); Blowhole Point, Marion Bay, 2 m alt., 2012, G. Kantvilas 341/12 (HO).

NEW SOUTH WALES. Boulder Bay, S of Tathra, 20 m alt., 2012, L.H. Cave 1786 (HO).

II. Pannarin chemotype:

TASMANIA: Sloop Rocks, near St Helens, 1963, *G.C. Bratt* 812 & *M.H. Bratt* (BM, HO); Spiky Bridge, seal-level, 1984, *G. Kantvilas* 167/84 & *P. James* (BM, HO); White Beach, sea-level, 2000, *G. Kantvilas* 84/00 (HO); Sulphur Creek, 2000, *G. Kantvilas* 158/00, 159/00 (HO); Rocky Cape, 10 m alt., 2001, *G. Kantvilas* 1159/01 (HO); Redbill Point, Bicheno, 3 m alt., 2002, *G. Kantvilas* 459/02 (HO); Bicheno, near the Gulch, 3 m alt., 2002, *G. Kantvilas* 460/02 (hb. van den Boom, HO); Wineglass Bay, sea-level, 2003, *G. Kantvilas* 731/03 (HO); Maignon Blowhole, Tasman Peninsula, 40 m alt., 2006, *G. Kantvilas* 360/06 (HO).

BASS STRAIT, CAPE BARREN ISLAND: The Corner, 1969, *J.S. Whinray* s.n.; MEL 1068311 pp (HO).

VICTORIA: c. 2 km SW of Mallacoota township on Betka Road, *V. Stajsic* 5704 pp (HO).

Acknowledgement

We thank Jean Jarman who provided the photograph of the new species and prepared the line drawing for publication and Jack Elix for helpful comments and suggestions on chemistry.

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New species of *Caloplaca* (lichenised Ascomycota: Teloschistaceae) from Kangaroo Island

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Abstract

The new species, *Caloplaca gilfillaniorum* Kantvilas & S.Y.Kondr. and *C. piscatorica* Kantvilas & S.Y.Kondr., are described and illustrated, and their relationships with other species are discussed. The closest affinities of the former are with the Australian species, *C. kaernefeltii* S.Y.Kondr., Elix & A.Thell, whereas those of the latter appear to be with the Antarctic endemic, *C. schofieldii* C.W. Dodge.

Key Words: biodiversity, lichens, littoral zone, mallee, South Australia.

Introduction

The lichen genus *Caloplaca* is one of the largest in the world. The number of species involved is difficult to estimate given the geographic gaps in knowledge, although recently Arup et al. (2013) suggested in excess of 1000 species for the family Teloschistaceae, of which *Caloplaca* is by far the largest genus. *Caloplaca* is truly cosmopolitan and is well represented at all latitudes (including subpolar regions) as well as at a wide range of altitudes, from the littoral zone to the summits of high mountains. Although found in most vegetation types, including forests, heathlands, savannah woodlands and deserts, it tends to favour more open habitats where it colonises all types of rock, soil, wood, bark and man-made substrates. The genus often occupies a very conspicuous and dominant place in the landscape, being responsible, for example, for the continuous yellowish and orange bands on coastal rocks throughout the world. However, many other species are less conspicuous, and may lack these pigments or have them limited only to their tiny fruiting bodies. In general, the genus is characterised by an essentially crustose thallus, biatorine to lecanorine apothecia, asci of the *Teloschistes*-type (Honegger 1978) and hyaline, polardiblastic ascospores; that is, two-celled spores where the locules are separated by a thick septum pierced by a central channel.

In recent years, the phylogeny and systematics of the whole Teloschistaceae has been under investigation using DNA sequence data (e.g. see Gaya et al. 2012). It has become evident that the genus as currently understood is artificial and simply a convenient 'place holder' for many crustose species that may be only distantly related (Søchting & Lutzoni 2002). A new overview of the family was published recently (Arup et al. 2013), employing 39 genera and extensively subdividing *Caloplaca* itself. However, as noted by those

authors, few of the genera can be recognised, at least at this stage, by traditional morphological and chemical characters, nor have all the species been included in the molecular analyses. Thus at least for the foreseeable future, it is inevitable and expedient that new taxa will continue to be described (and so brought to the attention of phylogenetic researchers) in *Caloplaca*, rather than in its newly instated segregate genera.

Australia is undoubtedly a hot-spot of speciation for the genus. Kondratyuk et al. (2012) list 122 species, based on an extensive investigation spanning many years that led to the description of many new taxa (Kärnefelt & Kondratyuk 2004; Kondratyuk et al. 2007a, 2007b, 2009a, 2009b, 2010, 2011; Lumbsch et al. 2011). The revision of the genus in Australia, however, is in no way complete, and many areas remain under-investigated and the description of further new species is underway.

Kangaroo Island, with its Mediterranean climate, extensive coastline, complex geology that includes calcareous and siliceous rock types, and wide range of heathlands and woodlands, is an ideal habitat for *Caloplaca*. Thus it was no surprise that despite the large number of species already documented for the southern Australian region, the detailed lichenological surveys of the first author yielded species new to science. For reasons indicated above, we describe these species in the genus *Caloplaca* pending molecular investigation of their phylogenetic relationships.

Methods

The study is based on collections of the authors, housed in the Tasmanian Herbarium (HO) and the lichen herbarium of M.H. Kholodny Institute of Botany of National Academy of Sciences of Ukraine (KW-L). Descriptions are based on hand-cut sections of the ascomata examined at high-power with a light

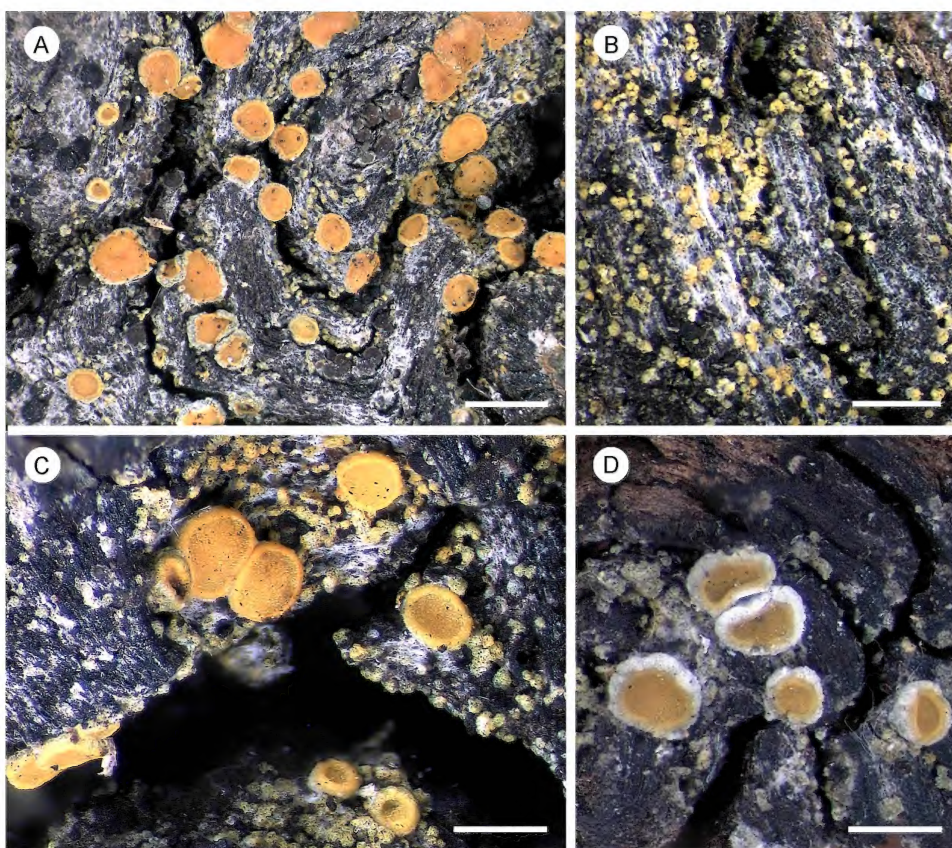


Fig. 1. *Caloplaca gilfillaniorum* (holotype): **A** general habit; **B** detail of sterile thallus comprising isidioid granules; **C** detail of young biatorine apothecia; **D** detail of zeorine apothecia with both the proper and the thalline exciples showing. Scale bar: **A** 1 mm, **B–C** 500 μ m.

microscope. Mounting media included water, 15% KOH and lactophenol cotton blue after pretreatment with KOH. Measurements given in the description of apothecial tissues, asci and ascospores are based on mounts in water only. Measurements of ascospores and ascospore septa are based on 100 observations for each species and are presented in the form 5th percentile–average–95th percentile; outlying values are given in brackets. The chemistry of the new species was determined by Prof. J.A. Elix, Canberra, using high performance liquid chromatography (Elix et al. 2003).

Taxonomy

1. *Caloplaca gilfillaniorum* Kantvilas & S.Y.Kondr., sp. nov.

Caloplacae kaernefeltii similis sed thallo isidioideo, sorediis destituto, apotheciis parvioribus, 0.3–0.8 mm latis, biatorinis vel zeorinis, ascosporis maioribus, 12–17 μ m longis, 6–8.5 μ m latis et O-methylvioxanthinum destituto differt.

Mycobank no.: MB804701

Typus: SOUTH AUSTRALIA, **Kangaroo Island:** Creek Bay Farm ('Carew'), 35°51'S 138°06'E, 100 m alt., on old dead mallee root in rough pasture, 25 Sep. 2011, G. Kantvilas 417/11 (holo.: HO 563154; iso.: AD, KW-L).

Thallus granular-areolate, forming irregular, undelimited patches to c. 10 cm wide, frequently interrupted by other lichens; individual areoles and granules minute, to 0.05–0.1 mm wide, greyish green to greenish yellow, becoming brighter yellow in more elevated parts, wart-like or becoming elongate, ascending and isidium-like, widely scattered and separate, rarely clustered together. *Apothecia* 0.3–0.8 mm wide, scattered, bright pure yellow, sometimes a little orange-yellow when older, mostly biatorine when very young, soon developing a thalline exciple, initially on the underside, at maturity mostly zeorine, with a \pm complete, minutely crenulate, greyish green thalline exciple, in section with outer parts interspersed with golden-yellow crystals that turn crimson and dissolve in KOH; disc concave at first, soon becoming plane or a little undulate when old; thalline exciple in section

Table 1. Salient characters of *Caloplaca gilfillaniorum* and some other corticolous or lignicolous species

taxon (source of data)	thallus	apothecia	apothecial disc	ascospores	hymenium	major chemical constituents	distrib.
<i>C. gilfillaniorum</i> (this paper)	of minute greyish green to greenish yellow, isidioid granules	biatorine to zeorine, 0.3–0.8 mm diam.	yellow	8/ascus, polardiblastic, 12–17 × 6–8.5 µm; septum 3–7 µm	without oil droplets	parietin	SA
<i>C. kaernefeltii</i> (Kondratyuk et al. 2009b)	absent, or of orange to orange-green granules that become isidioid or sorediate	lecanorine, 0.4–2 mm diam.	rose-red	8/ascus, polardiblastic, 12–13 × 6–8 µm; septum 4–7 µm	without oil droplets	parietin, <i>O</i> -methyl vioxanthin	WA, SA, Vic, Tas
<i>C. tibellii</i> (Kondratyuk et al. 2009b)	absent, or of scattered, whitish granules with abundant, yellow soredia	biatorine, 0.3–0.5 mm diam.	yellow	usually single in the ascus, polardiblastic, 13–16 × 5–7 µm; septum 5–7 µm	without oil droplets	parietin	WA
<i>C. bassiae</i> (this paper)	continuous, crustose, pale brownish to grey, with yellow, cylindrical isidia 50–60 µm wide	biatorine, 0.3–1 mm diam.	yellow to orange	8/ascus, polardiblastic, 13–25 × 7–9 µm; septum 6–11 µm	with numerous oil droplets	fragilin	Qld, NSW, extra-Austral.
<i>C. aseptatospora</i> (Kondratyuk et al. 2009b)	continuous, crustose, grey to whitish grey, with concolorous granular to ± spherical isidia 40–60 µm wide	zeorine to lecanorine, 0.4–0.9 mm diam.	brownish orange	1–2/ascus, mainly simple, 11–14 × 6–8 µm; septum 5–6 µm	without oil droplets	fragilin	Qld
<i>C. pulcherrima</i> (Kondratyuk et al. 2007b)	continuous, crustose, dark grey to brownish grey, with isidia-like schizidia 0.1–0.2 mm wide	biatorine, 0.6–1.5 mm diam.	blood red	8/ascus, polardiblastic, 10–12 × 6–7 µm; septum 3–5 µm	without oil droplets	lichexanthone	NSW, Tas, NZ
<i>C. sipmanii</i> (Kondratyuk et al. 2009a)	continuous, crustose, whitish, with cylindrical to coralloid isidia	biatorine, 0.8–1.2 mm diam.	yellowish	8/ascus, polardiblastic, 13–25 × 7–9 µm; septum 6–11 µm	without oil droplets	lichexanthone, rhein	Qld
<i>C. elixii</i> (Kärnefelt & Kondratyuk 2004)	continuous, crustose to squamulose, greenish yellow-orange, with marginal phyllidia and isidioid granules	lecanorine, 0.3–2 mm diam., yellow or whitish pruinose	brown-orange with a yellow or whitish pruina	8/ascus, 1–3 (–4)-septate, 16–21 × 5.5–7 µm; septum very thin	without oil droplets	not known	WA, SA, Vic, Qld, NSW, Tas
<i>C. yammeraensis</i> (Kondratyuk et al. 2009b)	continuous, crustose, greenish grey or dark grey, with whitish grey isidia-like schizidia and soredia	lecanorine, 0.4–1 mm diam.	dark brown, ± with a white pruina	8/ascus, polardiblastic, 15–19 × 7–8 µm; septum 5–9 µm	without oil droplets	nil	WA

60–90 (–100) µm thick, with a cortical layer 10–30 µm thick composed of hyphae to 3–5 µm wide; proper exciple 20–70 µm thick in the uppermost lateral part, composed of radiating, interwoven hyphae 2–5 µm wide, in the basal part (beneath the subhymenium) 20–40 µm thick, composed of rather parenchymatous hyphae 4–7 µm wide. *Subhymenium* 50–70 µm thick, hyaline, not interspersed with oil droplets. *Hymenium* 50–70 µm thick, not interspersed; *paraphyses* of the *bermaguiana*-type, 1.5–2 µm thick, with occasional oil cells 3–6 µm wide and apices usually expanded to 2.5–5 µm; *asci*

8-spored, 45–55 × 12–17 µm. *Ascospores* polardiblastic, ellipsoid to broadly fusiform, sometimes with somewhat attenuated apices, (11–) 12–14.2–17 (–18) × (5–) 6–7.1–8.5 (–10) µm; septum 3–5–7 (–11) µm thick. *Pycnidia* not found. **Fig. 1.**

Chemistry. Thallus and apothecia K+ brownish purple to crimson-purple; containing parietin, detected by h.p.l.c.

Etymology. This species is named in honour of Andy and Kate Gilfillan, friends of the first author and owners

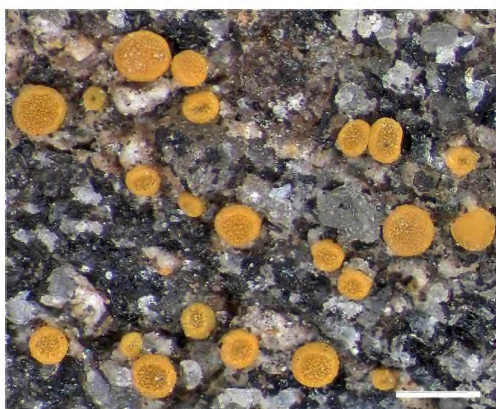


Fig. 2. *Caloplaca piscatorica* (holotype): habit. Scale bar 500 μ m.

of the property where the type specimen and many other fascinating lichens have been collected.

Ecology and distribution. At present, *Caloplaca gilfillaniorum* is known only from the type collection from the Dudley Peninsula, Kangaroo Island. It grew on the dead wood of old mallee lignotubers, scattered in a roughly cleared sheep pasture. Given its habitat, it is anticipated that this species is more widely distributed. Associated lichen species included *Amandinea lignicola* var. *australis* Elix & Kantvilas, *A. punctata* (Hoffm.) Coppins & Scheid., *Lecanora saligna* (Schr.) Zahlbr., *Lecidella xylogena* (Müll. Arg.) Kantvilas & Elix and a species of *Glonium*.

Remarks. *Caloplaca gilfillaniorum* appears to be most closely related to *C. kaernefeltii* S.Y.Kondr., Elix & A.Thell, which also has a poorly developed thallus of orange-green granules that may often be isidium-like. However, that species differs in that the thallus granules eventually become \pm sorediate, it has very distinctive, large (0.4–2 mm diam.), lecanorine apothecia with a red to rose-red or brownish red disc and white thalline exciple, and the ascospores, although falling within the range of those of *C. gilfillaniorum*, are somewhat shorter and narrower (12–13 \times 4–7 μ m); it also differs chemically by containing high concentrations of *O*-methylviioxanthin in addition to parietin. Significantly, *C. kaernefeltii* also occurs on Kangaroo Island, albeit in a starkly different habitat to *C. gilfillaniorum*, namely in swampy, *Melaleuca*-dominated coastal woodland. On the basis of thallus morphology alone, *C. gilfillaniorum* is also similar to *C. tibellii* S.Y.Kondr. & Kärnefelt, which also has a rather poorly developed, indistinct thallus and occurs on wood, but differs in becoming richly sorediate and having biatorine apothecia where the proper exciple is very thin and soon \pm excluded, making the apothecia appear immarginate.

In addition to these species, there are several other corticolous isidioid *Caloplaca* species in the

Australian flora with which the new species can be compared. These include: *C. bassiae* (Willd. ex Ach.) Zahlbr., *C. aseptatospora* S.Y.Kondr. & Kärnefelt, *C. pulcherrima* (Müll. Arg.) S.Y.Kondr. & Kärnefelt, *C. sipmannii* S.Y.Kondr., Kärnefelt, Elix & J.Vondrák, *C. elixii* S.Y.Kondr. & Kärnefelt and *C. yammeraensis* S.Y.Kondr., Kärnefelt & Elix. However, all these species present a combination of thallus, apothecial, ascospore and chemical characters starkly different from that of *C. gilfillaniorum* (see Table 1 for summary).

Due to its hard substrate (lignotubers), we also compared *C. gilfillaniorum* to some isidiate saxicolous species, notably *C. archeri* Kalb, S.Y.Kondr., Elix & Kärnefelt, *C. clavatoisidiata* S.Y.Kondr., Kärnefelt & J.Vondrák, *C. ferdinandmuelleri* S.Y.Kondr. & Kärnefelt and *C. kiamae* S.Y.Kondr. & Kärnefelt. Again, the combination of key characters clearly distinguishes these species from *C. gilfillaniorum* and, with the exception of *C. kiamae*, none of the species mentioned occurs in South Australia.

Molecular data is very limited for Australian *Caloplaca* species, although investigations by the second author (SYK) are ongoing and results will be reported elsewhere. However, molecular phylogeny data based on nuclear (ITS1/ITS2 and LSU portions) and mitochondrial (12S SSU) DNA sequences of *Caloplaca gilfillaniorum* and *C. kaernefeltii* confirm that these species are distinct and suggest that together they belong to a robust, monophyletic branch that also includes some South African species (S.Y. Kondratyuk, unpubl. data).

Also examined (*Caloplaca bassiae*)

[INDIA:] Malabar (H-ACH 1752, holotype). AUSTRALIA, QUEENSLAND: Green Island, 27.4 km NE of Cairns, 16°46'S 145°58'E, 0 m alt., 26.viii.1976, J.A. Elix 2597 (CANB); Eimeo Beach, near Mackay, 21°12'S 149°06'E, 60 m alt., 11.viii.1974 J.M. Gilbert 74/705 (HO); Newell Beach, 6 km NE of Mossman, 16°26'S 145°24'E, 3 m alt., 5.xii.1990, H. Streimann 45970 (CANB); Crediton State Forest, 16 km SW of Finch Hatton, 21°15'S, 148°31'E, 700 m alt., 1.vii.1986, J.A. Elix 21083 & H. Streimann (CANB).

2. *Caloplaca piscatorica* Kantvilas & S.Y.Kondr., sp. nov.

Caloplacae schofieldii similis sed apotheciis citrinis, persistente biatorinis et ascosporis brevioribus, 7.5–11 μ m longis, 4–5 μ m latis differt.

Mycobank no.: MB804702

Typus: SOUTH AUSTRALIA, **Kangaroo Island:** northern end of Antechamber Bay, 35°47'S 138°04'E, 0 m alt., on seashore rocks in underhangs and crevices, 18 September 2012, G. Kantvilas 510/12 (holo.: HO; iso.: AD, KW-L).

Thallus inapparent, evident at most by undelimited, paler areas of substrate or as pale greyish or brownish spots in the vicinity of the apothecia. **Apothecia** 0.25–0.6 mm wide, scattered or aggregated, bright citrine yellow, persistently biatorine, interspersed at the outer edges with yellow crystals that turn crimson and dissolve in KOH; disc persistently plane; proper exciple persistent, in section to 35–65 μ m thick in the uppermost lateral part

Table 2. Salient characters of *Caloplaca piscatorica* and some superficially similar species

taxon (source of data)	thallus	apothecia	apothecial disc	ascospores	major chemical constituents	ecology and distribution
<i>C. piscatorica</i> (this paper)	± absent	biatorine, 0.25–0.6 mm diam.	yellow	8/ascus, polardiblastic, 7.5–11 × 4–5 µm; septum 0.5–2.5 µm	parietin	sea-shore rocks; SA
<i>C. schofieldii</i> (Dodge 1973; Øvstedal & Lewis Smith 2001; this paper)	insignificant, areolate or granular on a black hypothallus	lecanorine, 0.2–0.4 mm diam.	orange-yellow to orange	8/ascus, polardiblastic, 9–13 × 4–6 µm; septum 1–2 µm	not known	rocks; Antarctica
<i>C. johnstonii</i> (Dodge 1948; Øvstedal & Lewis Smith 2001)	rimose-areolate and olive, or absent, with a beige hypothallus	lecanorine, 0.2–0.5 mm diam.	orange-yellow	8/ascus, polardiblastic, 10–13 × 5.5–7 µm; septum 2–3 µm	not known	sea-shore rocks; Antarctica and nearby islands
<i>C. cliffwetmorei</i> (Kondratyuk et al. 2009b)	very thin or endophloedal, whitish to whitish- grey, darkish grey near the apothecia	zeorine to lecanorine, 0.2–0.6 mm diam.	dull orange to brownish with yellow pruina	8/ascus, polardiblastic, 10–12 × 5–6 µm; septum 4–5 µm	parietin	bark; WA, Vic, Tas
<i>C. aegatica</i> (Giralt et al. 1992; Kondratyuk et al. 2004)	thin, crustose, continuous to rimose, grey to greyish-brown or greyish-yellow	zeorine, 1–1.8 mm diam., with a golden- yellow proper exciple and a greyish thalline exciple	orange to dark orange	8/ascus, polardiblastic, 10–15 × 7–9 µm; septum 5–8 µm	not known	bark; Mediterranean region and Atlantic islands

and composed of radiating, interwoven hyphae 3–5 µm thick with occasional oil cells to 7 µm wide, in the basal part becoming very thin and ± disappearing; scattered algal cells present below subhymenium. *Subhymenium* to 40–70 (–100) µm thick, interspersed with scattered oil droplets to 3–4 µm diam. *Hymenium* 45–65 µm thick, not interspersed with oil droplets; *asci* 8-spored, 35–48 × 11–15 µm; *paraphyses* 1.5–2 µm thick, sometimes with the uppermost cells with oil vacuoles to 2–3 (–4) µm diam. *Ascospores* polardiblastic, narrowly ellipsoid to somewhat widened at the septum, (6–) 7.5–9.2–11 (–12) × (3.5–) 4–4.5–5 (–6) µm; septum 0.5–1.5–2.5 (–3) µm thick. *Pycnidia* not found. **Fig. 2.**

Chemistry. Apothecia K+ crimson-purple; containing parietin, detected by h.p.l.c.

Etymology. The species epithet (derived from the Latin for ‘fishing’) alludes to the attributes of the type locality and the activities of the collector when this species was discovered.

Ecology and distribution. At present, *Caloplaca piscatorica* is known only from the type locality on the Dudley Peninsula, Kangaroo Island, where it grew on steeply sloping laterite rock plates along the sea shore. The upper parts of these rocks are abundantly colonised by a typical littoral community of crustose lichens that includes *Buellia aeruginosa* A.Nordin et al., *B. halonia* (Ach.) Tuck., *Caloplaca eos* S.Y.Kondr.

& Kärnefelt, *Catillaria austrolittoralis* Kantvilas & van den Boom, *Tylothallia pahiensis* (Zahlbr.) Hertel & Kilius and *Jackelia ligulata* (Körb.) S.Y.Kondr. et al. Whereas small thalli of *C. piscatorica* may occur in this association, the best colonies of this species tend to be restricted to sheltered crevices and underhangs, well within the zone of direct influence of sea-water, where *Verrucaria subdiscreta* P.M.McCarthy and only depauperate thalli of the species mentioned above grow.

Remarks. *Caloplaca piscatorica* is a distinctive species, recognised in the field by its lack of a visible thallus and its scattered, persistently biatorine, lemon-yellow apothecia. The apothecia resemble those of a species of *Candelariella* Müll.Arg., a genus that is readily distinguished from *Caloplaca* by the absence of K+ crimson, anthraquinone pigments, its *Lecanora*-type asci and simple ascospores.

On the basis of literature pertinent to the Southern Hemisphere (viz. Øvstedal & Lewis Smith 2001; Wirth & Kondratyuk 2010; Kondratyuk et al. 2012) and available herbarium material, the new species appears to be closest to two Antarctic endemic taxa, *C. schofieldii* C.W.Dodge and *C. johnstonii* (C.W.Dodge) Sochting & Olech. Both of these species differ from *C. piscatorica* chiefly by having lecanorine apothecia, an orange-yellow apothecial disc and somewhat larger ascospores, as well as in several more subtle features (see Øvstedal & Lewis Smith 2001 and Table 2). Dodge (1973) also describes a

black hypothallus in *C. schofieldii*, although no mention of this characteristic feature is made by Castello & Nimis (1995) who studied his type specimens. We also compared *C. piscatorica* to the corticolous Australian species, *C. cliffwetmorei* S.Y.Kondr. & Kärnefelt, and its Northern Hemisphere relative, *C. aegatica* Giralt, Nimis & Poelt. Both have zeorine to lecanorine apothecia, and display further thallus, apothecial and ascospore features that readily distinguish them from the new species (Table 2).

Additional specimen examined

SOUTH AUSTRALIA. **Kangaroo Island:** type locality, 18.x.2011, G. Kantvilas 489/11 (HO, LD, KW-L).

Also examined (*Caloplaca schofieldii*)

ANTARCTICA: Southern Victoria Land, Lower Taylor Valley, 77°40'S 163°14'E, 2.xii.1989, R.D. Seppelt 17773, 17774 (HO); Vestfold Hills, NE end of Lake Druzhby, 68°34'30"S 78°23'45"E, 15 m alt., 16.i.1979, R.D. Seppelt 8291 (HO); Ross Island, Cape Bird area, 77°14'13.5"S 166°25'12.5"E, 135 mm alt., 26.i.2000, R.D. Seppelt 21988 (HO).

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Two new species of *Sarcogyne* (lichenised Ascomycota: Acarosporaceae) from central and southern Australia

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Abstract

Two new lichens, *Sarcogyne iridana* P.M.McCarthy & Kantvilas and *S. meridionalis* P.M.McCarthy & Kantvilas (Acarosporaceae), are described and illustrated from sandstone in central Australia and from limestone, mainly in coastal habitats, in southern Australia, respectively. The widespread *S. regularis* Körb. is reported from Tasmania for the first time. *Sarcogyne calcifraga* (Müll.Arg.) H.Magn., based on collections from Egypt, is lectotypified, but it is excluded from the Australian lichen flora.

Key words: biodiversity, lichen, new species, taxonomy.

Introduction

The lichen genus *Sarcogyne* Flot. (Acarosporaceae) is characterised by a crustose and usually inconspicuous thallus that is often immersed in the substratum, reddish brown to black apothecia with a lecidine exciple, a non-carbonised epihymenium, simple to sparingly branched (but not anastomosing) paraphyses, and asci that contain (50–) 100–200 minute simple ascospores (Magnusson 1935a, b, 1937; Golubkova 1977, 1988; Clauzade & Roux 1985; Knudsen & Standley 2007; Fletcher & Hawksworth 2009). Currently with c. 34 accepted species, it grows on calcareous and siliceous rocks, and less commonly on soil. However, while variability in some of the most common species has prompted the description of numerous infraspecific taxa, several have been inadequately collected and documented and remain poorly understood. Recent research by Knudsen and co-workers, especially in North America, has seen a re-examination of type specimens, a thorough analysis of many old and often misapplied names, and the description of new taxa, all building towards a revision of the genus based on molecular and morphological methods which aims to clarify the circumscription and affinities of *Sarcogyne* and its species (Knudsen & Standley 2007; Knudsen & Kocourcová 2011).

Sarcogyne is most diverse in temperate and semi-arid regions (especially in Europe, North Africa and North America), but is less so in the subtropics and wet-tropics and at subpolar latitudes. The genus is poorly known in the Southern Hemisphere, with very few records from South America, Antarctica, New Zealand and the South Pacific. Four species have been reported from Australia, viz. *S. clavus* (DC.) Kremp. and *S. privigna* (Ach.) A.Massal. from the south-west of Western Australia (Richardson & Richardson 1982), *S. regularis*

Körb. from all southern mainland States (McCarthy 2013), and *S. calcifraga* Müll.Arg. from south-western Victoria (Müller 1893). Here we describe *S. iridana* from sandstone outcrops in arid central Australia and *S. meridionalis* from limestone in south-eastern South Australia and Flinders Island, Tasmania. We also report *S. regularis* from Tasmania and discuss the identity of the Australian specimen attributed to *S. calcifraga*.

Methods

Observations and measurements of photobiont cells, thallus and apothecium anatomy, asci and ascospores were made on hand-cut sections mounted in water and dilute KOH (K). Asci were also observed in Lugol's Iodine (I), with and without pretreatment in K.

Taxonomy

Sarcogyne iridana P.M.McCarthy & Kantvilas, sp. nov.

Thallus epilithicus, diffusus, albidus, 15–25 µm crassus. *Apothecia* superficiales, atra, plana vel valde convexa aut subglobosa, (0.33–) 0.60 (–1.14) mm diametro, plerumque epruinosa. *Excipulum* proprium pallidiore vel disco concoloratum, tenue persistensque aut excludens, 20–40 (–60) µm crassum, non carbonaceum, annulatum. *Hypothecium* 80–140 µm crassum, incoloratum. *Hymenium* 65–85 (–100) µm crassum, amyloideum, non inspersum. *Paraphyses* simplices, 1–2 µm crassae. *Asci* clavati vel cylindricoclavati, c. 150–180-spori, 60–88 µm longi, 13–22 µm lati. *Ascospores* simplices, (3–) 5 (–7) µm longae, (1.5–) 2 (–2.5) µm latae.

Mycobank No.: MB804752.

Typus: AUSTRALIA, NORTHERN TERRITORY, c. 75 km S of Alice Springs, ESE of Rainbow Valley, 24°20'33"S, 133°39'22"E, on sandstone outcrop in dry scrub, 22 Oct. 2005, G. Kantvilas 283/05 (holo.: HO 533881).

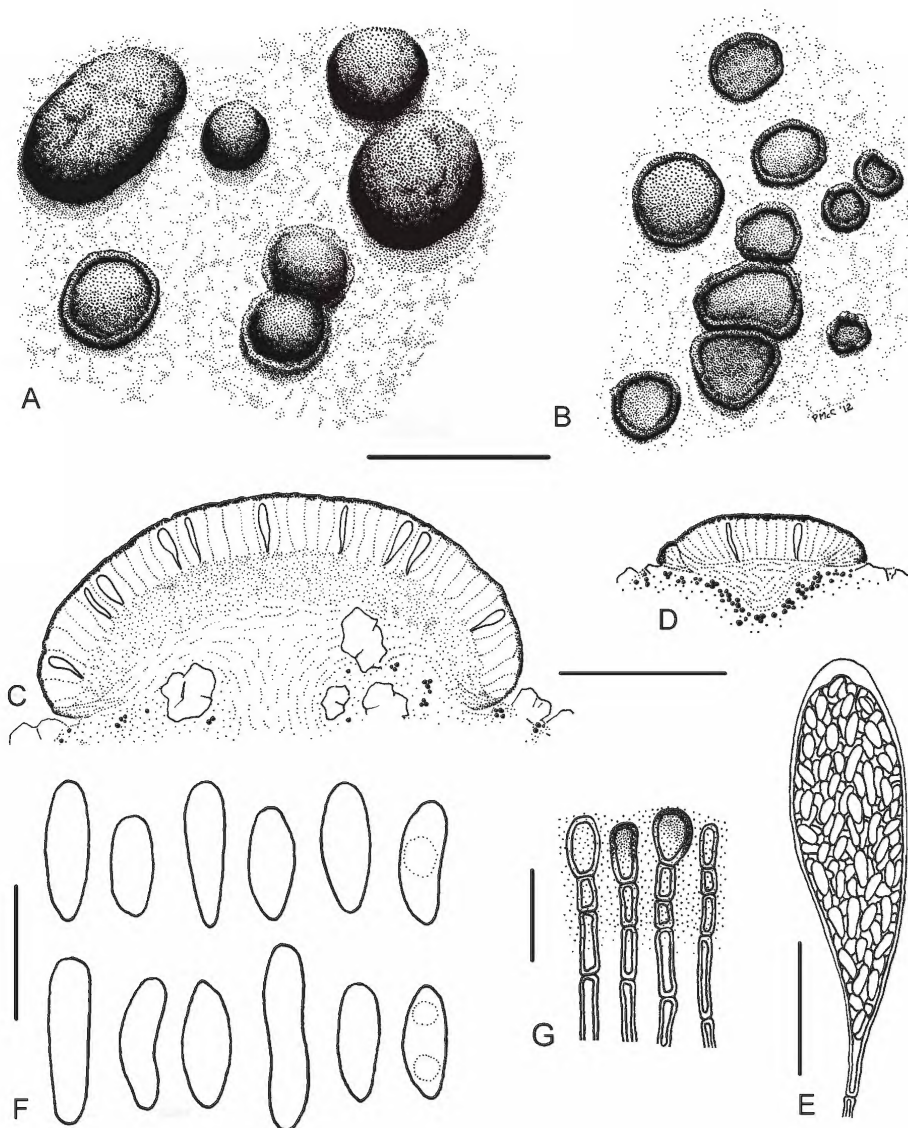


Fig. 1. *Sarcogyne iridana*. A–B habit of thalli and apothecia; C–D sectioned apothecia and adjacent thallus (semi-schematic); E mature asci; F ascospores; G epiphytenium. Scale bars: A–B 1 mm; C–D 0.2 mm; E 20 μ m; F 5 μ m; G 10 μ m. — A, C, E–G holotype; B, D Kantvilas 290/05.

Thallus crustose, epilithic, diffuse, occupying minute depressions in the substratum or following micro-crevices around rock crystals, whitish, 15–25 μ m thick, forming colonies to c. 5 cm wide; cortex absent; mycobiont hyphae short-celled, 2–2.5 μ m wide; photobiont cells chlorococcoid, 8–16 μ m diam., scattered or in small clusters, not forming a distinct layer except, occasionally, beneath apothecia; prothallus not apparent.

Apothecia numerous, solitary, paired, in clusters of 3 or 4, or in short rows, superficial, lecideine, (0.33–) 0.60 (–1.14) mm diam. [$n = 110$]; disc dull black, the colour unchanged when wetted, occasionally plane, usually moderately to markedly convex or subglobose and then strongly constricted at the base (often appearing almost substipitate), rarely faintly grey-pruinose, the surface smooth to irregularly uneven or minutely and

shallowly rimulose; proper exciple concolorous with the disc or a little paler, usually epruinose, the outer edge occasionally faintly grey-pruinose, persistent and uniformly very thin or becoming excluded (especially in strongly convex to subglobose apothecia), smooth, even or undulate; in section the exciple non-carbonised, 20–40 (–60) μm thick, annular, not continuous beneath the hypothecium, the outer edge dark brown, internally hyaline to pale brown, the cells compacted, thick-walled, $3\text{--}4 \times 2\text{--}3 \mu\text{m}$. *Hypothecium* hyaline, 80–140 μm thick, interspersed with granules, merging below with a discrete or poorly defined thalline layer, 1– (with or without pretreatment in K). *Hymenium* 65–85 (–100) μm thick, the cut surface of a sectioned apothecium often appearing pale orange-brown; thin section not interspersed with oil droplets, granules or crystals, 1+ persistently deep blue (after pretreatment in K), subtending a diffusely medium brownish, 10–20 μm thick epihymenium. *Paraphyses* unbranched, long-celled, 1–2 μm wide, separating readily in water and K; apices usually strongly capitate, 4–5 (–6) μm wide, the apical cell with a partially brown-pigmented wall. *Asci* clavate to clavate-cylindrical, containing c. 150–180 ascospores, 60–88 \times 13–22 μm [$n=20$], with a tapering stalk; apex rounded to somewhat truncate; submature asci with a thick uniformly amyloid tholus and a distinct ocular chamber. *Ascospores* colourless, simple, ellipsoid to elongate-ellipsoid or bacilliform, lacking a distinct perispore, often 1–2-guttulate, (3–) 5 (–7) \times (1.5–) 2 (–2.5) μm [$n=75$]. *Pycnidia* not seen. **Fig. 1.**

Etymology. The specific epithet is based on the Latin *iridis* (of a rainbow) and the suffix *-ana*, in reference to the type locality, Rainbow Valley.

Remarks. The principal diagnostic characters of the new species are the very thin, diffuse, whitish thallus growing on siliceous rock, moderately large, black, epruinose apothecia that become immarginate and markedly convex to subglobose and basally constricted, a non-carbonised exciple, simple capitate paraphyses, polysporous asci and comparatively elongate, simple ascospores. *Sarcogyne regularis*, the most common and widely distributed species of the genus in Australia and globally, almost invariably grows on limestone, but it has larger, plane to only slightly convex apothecia that are persistently marginate and have a white-to bluish grey-pruinose disc (Knudsen & Standley 2007; Fletcher & Hawksworth 2009). Although the widespread *S. privigna* occurs on both siliceous and calcareous rocks, its epruinose apothecia have a plane, dark reddish disc and a persistent, often jointed and variably carbonised exciple up to 0.3 mm thick (Knudsen & Standley 2007; Fletcher & Hawksworth 2009; Knudsen & Kocourcová 2011). *Sarcogyne clavus*, an exclusively silicolous species with a distribution that also includes south-western Australia, has much larger apothecia (commonly to 3 mm wide) with a thicker, crenulate and carbonised exciple and a dark

brown hypothecium (Magnusson 1935b; Knudsen & Standley 2007; Fletcher & Hawksworth 2009). Finally, the predominantly silicolous *S. similis* H.Magn., known from the U.S.A., Greece (Poelt & Vězda 1974) and Zimbabwe (Becker, 2002), has larger and sometimes clustered apothecia, often with a thicker exciple, and paraphyses with apical cells that are not or scarcely expanded (Magnusson 1935a; Knudsen & Standley 2007).

Distribution & habitat. *Sarcogyne iridana* is known only from sandstone outcrops in dry scrub at the type locality in the far south of the Northern Territory. The abundantly fertile type specimen grows near thalli of *Peltula* aff. *placodizans* (Zahlbr.) Wetmore and *Lecanora pseudistera* Nyl. Also present on rocks nearby were *Xanthoparmelia colensoidea* Elix, *X. filarszkyana* (Gyeln.) Hale, *X. isidiosa* (Müll.Arg.) Elix & J.Johnst. and an unidentified species of *Pyrenopsis*.

Additional specimen examined

NORTHERN TERRITORY. Type locality, 22 Oct. 2005, G. Kantvilas 290/05 (HO 533888).

Sarcogyne meridionalis P.M.McCarthy & Kantvilas, sp. nov.

Thallus endolithicus vel subepilithicus, 30–70 μm crassus. *Apothecia* immersa, atra, plana vel concava, (0.17–) 0.27 (–0.40) mm diametro, plerumque epruinosa. *Excipulum* proprium tenue, persistens aut excludens, 25–50 μm crassum, non carbonaceum, annulatum vel continuum. *Hypothecium* 30–60 (–80) μm crassum, incoloratum. *Hymenium* 60–90 (–110) μm crassum, amyloideum, non inspersum. *Paraphyses* simplices, 1.5–2 (–3) μm crassae. *Asci* clavati vel cylindricoclavati aut ellipsoidei, c. 150–200-spori, 60–75 μm longi, 14–32 μm lati. *Ascospores* simplices, (3–) 4.5 (–6) μm longae, (1.5–) 2 (–2.5) μm latae.

Mycobank No.: MB804753.

Typus: SOUTH AUSTRALIA. **Kangaroo Island:** Pelican Lagoon, 35°48'S, 137°48'E, alt. 20 m, on limestone rocks in rough paddock, 27 Sep. 2012, G. Kantvilas 413/12 & B. de Villiers (holo.: HO 567046).

Thallus crustose, endolithic and inconspicuous or subepilithic and continuous to sparingly rimose, off-white to pale grey and up to 30–70 μm thick; cortex absent; mycobiont hyphae short-celled, 3–5 μm wide; photobiont cells chlorococcoid, 8–16 μm diam., scattered or in rather large clusters (in subepilithic thalli), not forming a distinct layer; prothallus not apparent. *Apothecia* numerous, lecidine, solitary, paired, in clusters of 3–6 or in irregular rows of up to 10, rounded or broadly ellipsoid, although the shape commonly distorted and angular due to mutual pressure, immersed in the substratum and leaving shallow pits after their decay, (0.17–) 0.27 (–0.40) mm diam. [$n=100$]; post-mature apothecia often becoming greenish white as the exciple and epihymenium lose their pigmentation and the hymenium disintegrates; disc jet-black when dry, dark reddish brown to dull black when wetted and becoming slightly pulpy and translucent, plane to deeply concave,

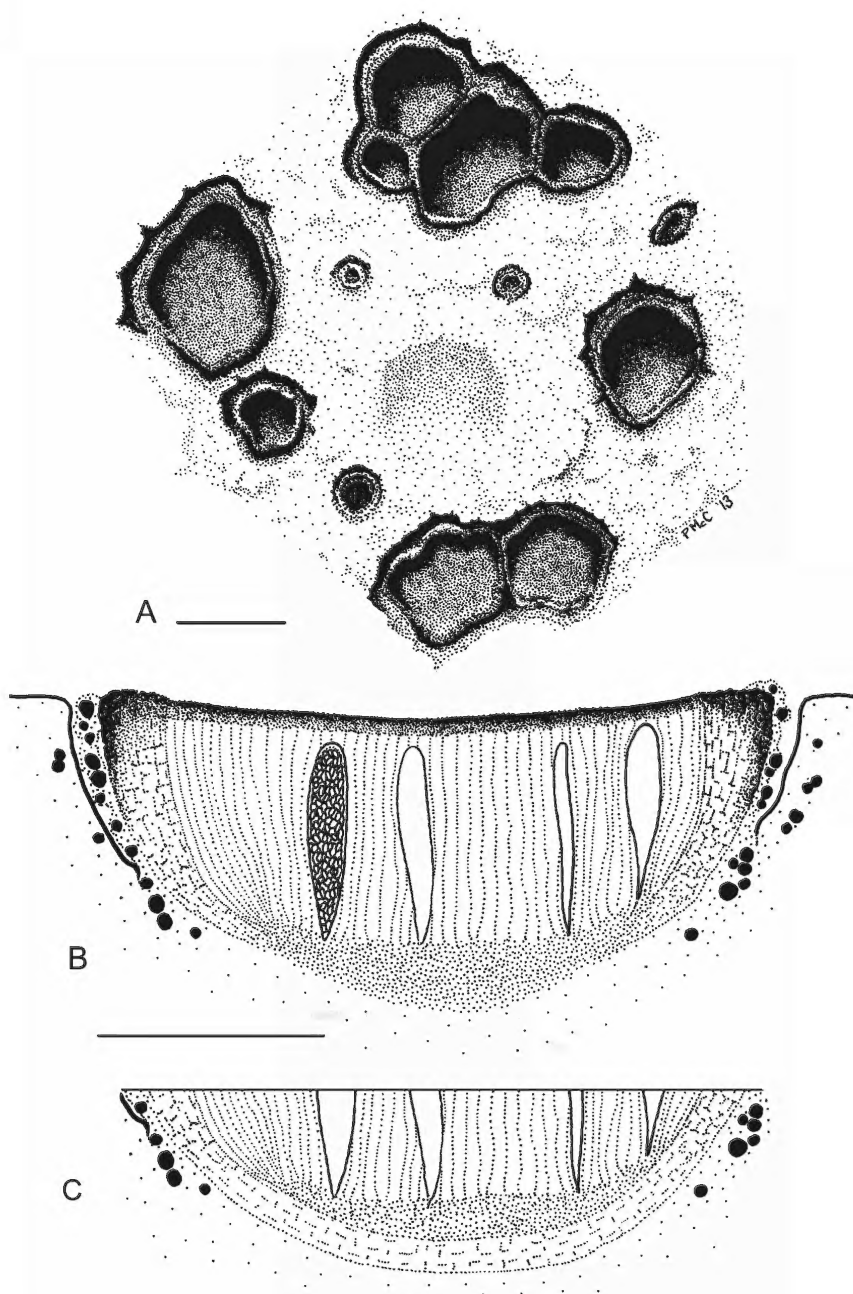


Fig. 2. *Sarcogyne meridionalis*. A apothecia on an endolithic thallus; B sectioned apothecium with an annular exciple (semi-schematic); C part of a sectioned apothecium with the exciple continuous beneath the hypothecium (semi-schematic). Scale bars: A 0.2 mm; B–C 0.1 mm. — A–B holotype; C Kantvilas 443/12.

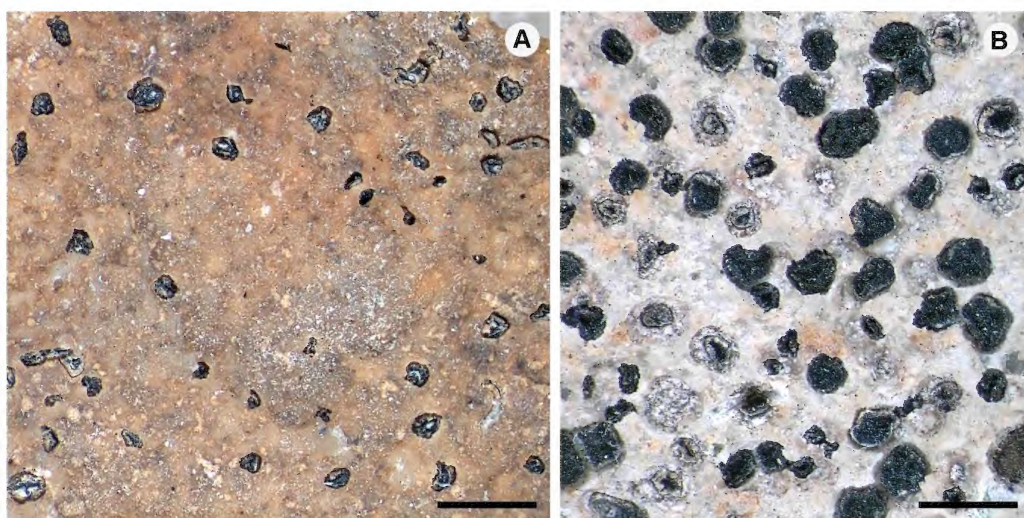


Fig. 3. **A** *Sarcogyne calcifraga* (lectotype), habit, showing minute apothecia immersed in pits. **B** *Sarcogyne* sp. (Wilson 817), with relatively broad apothecia with a well-developed exciple. Scale bars: 1 mm.

smooth, occasionally faintly grey-pruinose; proper exciple dark brown to jet-black, persistent and moderately thick or inconspicuous, or becoming excluded, usually epruinose, but the exciple of immature apothecia often with a very thin, uneven, whitish encrustation of thallus; in section the exciple non-carbonised, 25–50 μm thick, either annular or continuous beneath the hypothecium, outer edge dark brown, internally hyaline to pale brown, the cells compacted, rather thick-walled, 8–12 \times 2–3 μm , K–. *Hypothecium* hyaline, 30–60 (–80) μm thick, occasionally interspersed with granules, I– (with or without pretreatment in K). *Hymenium* 60–90 (–110) μm thick, not interspersed with oil droplets, granules or crystals, I+ persistently blue-violet (after pretreatment in K), I+ pale blue-violet, rapidly changing to reddish orange (without pretreatment), subtending a medium brownish, 10–15 μm thick epihymenium, itself topped by a 2–4 μm thick, hyaline amorphous coat. *Paraphyses* unbranched, long-celled, 1.5–2 (–3) μm wide, the cytoplasm granulose and minutely guttulate, separating readily in water and K (although the apical cells often remaining tightly coherent); apices usually strongly capitate, 3–4 (–5) μm wide, the apical cell with a partially brown-pigmented wall. *Asci* clavate to clavate-cylindrical or ellipsoid, containing 150–200 ascospores, 60–75 \times 14–32 μm [$n = 20$], with a tapering stalk; apex rounded; submature asci with a thick uniformly amyloid tholus and a distinct ocular chamber. *Ascospores* simple, colourless, ellipsoid to elongate-ellipsoid or somewhat panduriform, lacking a distinct perispore, (3–) 4.5 (–6) \times (1.5–) 2 (–2.5) μm [$n = 100$]. *Pycnidia* not seen. **Fig. 2.**

Etymology. The specific epithet, the Latin *meridionalis* (southern), refers to the known Australian and global distributions of the new lichen.

Remarks. This highly distinctive *Sarcogyne* is characterised by its endolithic to thinly subepilithic thallus, and very small, immersed apothecia that are solitary, paired, clustered or form rows, each having a dull black and deeply concave, epruinose disc and a usually thin, non-carbonised exciple that in section can form a partial ring or a continuous layer beneath the hypothecium.

The apothecia of the new species are very much smaller and more thinly marginate than those of *S. regularis*, the epruinose disc being plane to deeply concave rather than plane to convex and distinctively bluish- or white-pruinose. Furthermore, the larger apothecia and the thicker and carbonised exciple of *S. privigna* are certainly sufficient to distinguish it from *S. meridionalis*, while *S. algoviae* H.Magn., known from central Europe and Scandinavia, has immersed apothecia 0.3–0.5 mm diam. with a very thin hymenium (50–60 μm) and a fissured and carbonised exciple (Magnusson 1935b; Clauzade & Roux 1985; Knudsen & Kocourcová 2008).

Sarcogyne calcifraga (Müll.Arg.) H.Magn., based on two specimens from Egypt¹, also superficially resembles *S. meridionalis*, particularly with respect

¹ *Sarcogyne calcifraga* (Müll.Arg.) H.Magn., Meddel. Göteborgs Träd. 12: 101 (1938); *Lecidea simplex* var. *calcifraga* Müll.Arg., Revue Mycol. 2: 79 (1880). — **Type citation:** “Habitat calcicola in deserto Wadi Cherese et in Wadi Na-umieh: Schweinf.” **Lectotype (here designated):** in deserto aegypt. [Egypt], Wadi Cherese, 1877, G.A. Schweinfurth (G!). **Residual syntype:** in deserto aegypt. [Egypt], Wadi Na-umieh, 1879, G.A. Schweinfurth (G!). — The two specimens cited by Müller (1879) were located in his herbarium in Geneva. The one from Wadi Na-umieh is a minute fragment of rock with about 16 apothecia. The second specimen is considerably larger and is here selected as the lectotype. We are not aware of any duplicates of Schweinfurth’s specimens in other herbaria.

to the limestone habitat, endolithic thallus and sunken epruinose apothecia (Fig. 3A). However, this species differs in the following characters: the apothecia are smaller, 0.12–0.25 mm wide, and the degree of dark pigmentation is even less than in *S. meridionalis*, so that when moistened, they turn reddish brown. When dry, the disc is deeply concave, and the exciple is pulled away from the walls of the pit in the rock and inflexed, partly covering the disc. Chiefly because of adhering specks of substratum, this inflexed exciple looks rather pale, as noted by Magnusson (1937), although his allusion to *Arthonia* is incomprehensible. In section, the exciple is extremely reduced (at most 5–10 µm thick) and reddish brown at the upper edge. The paraphyses are more slender than in *S. meridionalis*, being only 1.5–2 µm wide. Moreover, the ascospores of the Egyptian species are ellipsoid and broader than those of the Australian lichen (5–7 × 2.5–4 µm vs 3–6 × 1.5–2.5 µm).

Distribution & habitat. *Sarcogyne meridionalis* occurs in a broad range of microhabitats on weathered and more recently exposed limestone outcrops and boulders in remnant mallee scrub, paddocks and roadsides in Yorke Peninsula, Kangaroo Island and the Murray River Region of south-eastern South Australia and on Flinders Island, Bass Strait, Tasmania. Associated lichens in South Australia include *Aspicilia contorta* (Hoffm.) Kremp., *Buellia albula* (Nyl.) Müll.Arg., *Caloplaca mereschkowskiana* S.Y.Kondr. & Kärnefelt, *Caloplaca* spp., *Lecania turicensis* (Hepp) Müll.Arg., *Lecanora dispersa* (Pers.) Sommerf., *L. sphaerospora* Müll.Arg., *Rinodina bischoffii* (Hepp) A.Massal., *Verrucaria calciseda* DC., *V. compacta* (A.Massal.) Jatta, *V. minor* Breuss, *V. muralis* Ach. and *V. nigrescens* Pers.

Additional specimens examined

SOUTH AUSTRALIA. Kangaroo Island: slopes above Red House Bay, 35°49'S, 138°07'E, alt. 50 m, on limestone outcrops in paddock, 17 Sep. 2012, G. Kantvilas 443/12 (AD, HO 567206); Flour Cask Bay, on coastal limestone, 6 Jan. 2013, A. Wells s.n. (CANB). **Yorke Peninsula:** Stansbury–Yorketown road, 4 km S of Stansbury, 34°56'06"S, 137°45'09"E, alt. 25 m, on limestone rubble in mallee scrub remnant, 11 Apr. 2013, P.M. McCarthy 4036 (AD); Yorketown–Warooka road, 11 km E of Warooka, 35°01'13"S, 137°30'23"E, alt. 38 m, on limestone among scattered *Melaleuca*, 10 Apr. 2013, P.M. McCarthy 4006 (AD). **Murray River Region:** Brookfield Conservation Park, 12 km NW of Blanchtown, 34°22'59"S, 139°29'43"E, alt. 85 m, on limestone rubble and outcrops in mallee scrub remnant, 13 Apr. 2013, P.M. McCarthy 4038, 4039 (AD, CANB); Chaunceys Line Road, 18 km E of Hartley, 35°15'28"S, 139°10'19"E, alt. 15 m, on limestone rubble and outcrops in mallee scrub remnant, 14 Apr. 2013, P.M. McCarthy 4035 (AD, CANB); Boundary Road, c. 10 km N of Tailem Bend, 35°10'16"S, 139°27'55"E, alt. 55 m, on limestone rubble and outcrops in mallee scrub remnant, 14 Apr. 2013, P.M. McCarthy 4025, 4026 (AD, CANB).

TASMANIA. Flinders Island: c. 0.5 km SE of Mt Killiecrankie, 39°49'S, 147°51'E, alt. 120 m, on fragment of calcified rock in blown out sand-hollow, 22 Jan. 2006, G. Kantvilas 38/06 & B. de Villiers (HO 536675).

Sarcogyne calcifraga not in Australia

The Victorian specimen (Wilson 817; Fig. 3B), labelled as *Lecidea simplex* var. *calcifraga* Müll. Arg. and reported by Müller (1893), is conspecific with neither *S. calcifraga* nor *S. meridionalis*. It has an endolithic thallus in a limestone substratum and epruinose apothecia 0.3–0.6 mm wide, immersed in pits, black when dry and dark brown when wetted. The exciple is thin, non-carbonised in section, c. 60 µm thick and reddish brown at the upper edge, while the robust paraphyses are 2–3 µm wide and the ascospores are comparatively narrow (1.5–2.5 µm). Consequently, *S. calcifraga* can be removed from the Australian lichen census (McCarthy 2013).

Several other specimens of *Sarcogyne* studied, from the south-west of Western Australia and South Australia (Kangaroo Island, Yorke Peninsula and the Murray River Region), are conspecific with or closely related to Wilson's specimen and likewise cannot be accommodated in *S. meridionalis* or related taxa (e.g. *S. privigna* and *S. regularis*). These endolithic to subepilithic specimens also tend to have predominantly immersed, occasionally very thinly grey- or bluish-pruinose apothecia, 0.3–0.55 (–0.65) mm diam. that often form clusters or rows and can be angular or otherwise distorted due to mutual pressure, with a comparatively thick apothecial exciple that is smooth and entire and a plane or slightly concave disc. In contrast, in terms of apothecial anatomy, there is little to characterise them. These problematic collections require further field study and careful comparison with extra-Australian taxa.

Specimens examined

SOUTH AUSTRALIA. Kangaroo Island: West Bay, Flinders Chase National Park, 15 km SSW of Cape Borda, 35°53'S, 136°33'E, alt. 40 m, on sloping limestone platform with scattered shrubs, 29 Sep. 1994, H. Streimann 55024 (CANB).

Yorke Peninsula: Stansbury–Yorketown road, 4 km S of Stansbury, 34°56'06"S, 137°45'09"E, alt. 25 m, on limestone rubble in mallee scrub remnant, 11 Apr. 2013, P.M. McCarthy 4037 (AD); Brookfield Conservation Park, 12 km NW of Blanchtown, 34°22'59"S, 139°29'43"E, alt. 85 m, on limestone rubble and outcrops in mallee scrub remnant, 13 Apr. 2013, P.M. McCarthy 4040–4044 (AD, CANB);

VICTORIA. near Warnambool, on calcareous rock, 1892, F.R.M. Wilson 817 (G).

WESTERN AUSTRALIA. Hamelin Bay, 34°13'S, 115°02'E, alt. 12 m, on soft, coarse coastal limestone, 12 Nov. 2011, G. Kantvilas 428/11 (HO 563409, PERTH).

Sarcogyne regularis Körb.

This species is characterised by (0.3–) 0.4–1.5 (–2) mm wide immersed or sessile apothecia with a red-brown to black, typically thickly whitish- to bluish grey-pruinose disc, a black, often thickly pruinose proper exciple and ellipsoid ascospores, 3–5 (–6) × 1.5–2 µm (Fletcher & Hawksworth 2009). It appears to be rather common on calcareous rocks, mortar, cement and (rarely) on soil in natural and urban habitats in temperate Australia, having been reported from Western Australia, South Australia, Victoria, New South Wales

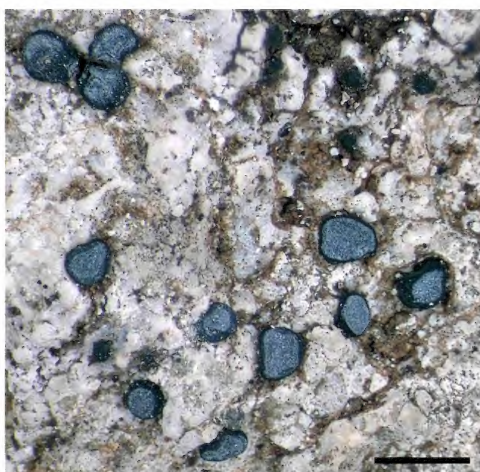


Fig. 4. *Sarcogyne regularis*, habit. Scale bar: 1 mm. — Kantvilas 172/98.

and the Australian Capital Territory (McCarthy 2013). The following specimen citations are the first to be published for Tasmania (Fig. 4).

Specimens examined

TASMANIA, near Liena Road and Mersey Forest Road junction, 41°34'S, 146°15'E, 350 m alt., on limestone outcrops in pasture, 19 Feb. 1984, G. Kantvilas 366/84C & P. James (BM, HO); Tunbridge, Midland Hwy near northern exit from township, 42°09'S, 147°25'E, 200 m alt., on lumps of calcrete on basalt-derived soil along roadside, 9 Sep. 1998, G. Kantvilas 172/98 (HO); Cascades, Hobart, 42°54'S, 147°17'E, 130 m alt., on old concrete in suburban garden, 6 Sep. 1998, G. Kantvilas 165/98 (HO).

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Euphrasia amplidens W.R.Barker (Orobanchaceae), a new and very localised species from western Tasmania

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Abstract

This new species of *Euphrasia* sect. *Striatae* is known from the Wilson and Harman river catchments of the Pieman River watershed, western Tasmania. It occurs on open ultramafic pans surrounded by sclerophyllous heath and shrubby eucalypt woodland. It was known from a single fragment in the National Herbarium of Victoria collected during the 1800s, but not formally named. Now, recently collected from three closely separated sites, the species is described and illustrated. It is clearly naturally rare, although its conservation status needs clarification through further field survey.

Key words: *Euphrasia* sect. *Striatae*, new species, rare, localised, threatened, serpentine-endemic, Tasmania.

Introduction

Specimens of a distinctive new species of *Euphrasia* were collected in 2011 in the Pieman River catchment in Tasmania's west coast region. The entity matched a specimen collected in the 1800s from "Tasmania", previously identified as distinctive, but as yet undescribed (Barker 1982). This paper formally describes the new species, another Tasmanian endemic *Euphrasia* with an apparently highly localised distribution and precarious conservation status.

Taxonomy

Euphrasia amplidens W.R.Barker, sp. nov.

Holotype: Tasmania, catchment of the Wilson River, north of Pieman Road [specific locality details withheld], c. 115 m alt., 7 Dec. 2011, M. Wapstra & B. French s.n. (AD 250975). **Isotypes:** HO, MEL.

Euphrasia Sect. *Striatae* unnamed taxon: W.R.Barker, *J. Adelaide Bot. Gard.* 5: 107 (1982), in note.

Perennial herb, c. 6–13 cm or more tall (long branches in *Milner 16* lack their base), with a few to several ascending to erect branches arising from ground level up to the lower 30% of the length of the main branches (stem of first year plants not observed). *Stem* not seen (no first year plants in collection); main inflorescence-bearing branches c. 5–8.5 cm or more high to the base of the inflorescence, with distal erect parts simple or with shoots; upper 2–4 internodes longer than leaves, the longest internode 3–4.5 times the length of the upper leaves; axis with opposite rows

of short to moderately long eglandular hairs, absent between, with scattered to moderately dense glandular hairs 0.15–0.3 mm long, denser towards upper parts, sometimes throughout, sometimes absent at base, sometimes absent for most of length. *Cotyledons* not seen. *Leaves:* uppermost leaves of main inflorescence-bearing branches sub-spathulate, 3.5–5.8 × 2–4 mm; base long, narrowly attenuate, petiole-like; teeth 1 along each margin, bluntly obtuse, about ½-way along the leaf, 0.5–0.6 (–0.8) mm long; apical tooth bluntly broadly acute, 1.7–2.0 (–2.2) × 1.8–2.5 (–2.8) mm, with sessile gland patches exposed on the underside in the distal ½ of the leaf; lower leaves of similar dimensions, those on basal parts and on shoots much smaller. *Inflorescences* (seen early in flowering) but for lowermost 0–2 nodes dense racemes bearing c. 8–16 or more flowers, with lowest one or two nodes bearing 1–2 flowers; rachis as for axis, but the glandular indumentum dense; pedicels of lowermost flowers 1–1.5 mm long, shorter towards apex; apical bud cluster oblong-ellipsoid, initially c. 1–2 cm long. *Bracts* similar to upper leaves, but densely glandular hairy. *Calyx* c. 3–5 mm long, green, lined on margins and midlines of teeth and below clefts in black, covered externally by dense to moderately dense glandular hairs 0.2–0.3 mm long, internally on the distal half of the teeth by moderately dense glandular hairs 0.2 mm long; teeth narrow deltoid, bluntly acute, the median clefts c. 2.4–3.5 mm deep, the lateral clefts c. 1.8–2.8 mm deep. *Corolla* c. (6–) 8.5–9.5 mm long along the upper side, coloured blue-purple in mature bud, in flower blue purple on hood, paler whitish fine blue-



Fig. 1. *Euphrasia amplidens*. A growth habit; B flower (from front); C flower (part side on).

purple lines on front of lobes, darker behind, becoming darker after anthesis, with mid yellow spot on lower side of mouth and deep in throat at point of insertion of stamens; *tube* c. 5.0–5.5 mm long, externally glabrous, but for distal extension of hood indumentum and short glandular hairs at separation of lips; *hood* c. 4.0 mm long, including lobes c. 5–5.5 mm broad, excluding lobes c. 2.5–3 mm broad, externally covered with dense, moderately long (0.2 mm), antrorse eglandular hairs, internally with long fine eglandular hairs at distal end behind upper cleft, otherwise apparently glabrous, the *upper lobes* facing forward in more or less same plane, erose-truncate or shallowly emarginate, glabrous behind, with cleft between c. 1.7 mm deep; *lower lip* concave from above, downturned, c. 8 × 9–10 mm, glabrous externally proximal parts covered by sparse to dense short eglandular hairs mixed with scattered short glandular hairs, distally glabrous, the lower lobes shallowly emarginate, with clefts between c. 4 mm deep. *Stamens* with *filaments* glabrous, the anterior pair c. 4–4.5 mm long, the posterior c. 3.5–4 mm long; *anthers*

c. 1.6–1.7 × 0.9–1.05 mm, mid brown, with *connectives* glabrous, with *slits* almost glabrous, lined distally by dense, very short hairs overlain by sparse short to long eglandular hairs, with rearmost pair of *awns* c. 0.35–0.6 mm long, longer than other three awn pairs c. 0.2–0.3 mm long. *Ovary* laterally compressed, in lateral view oblong-ovate, with rounded apex, covered by dense antrorse setae 0.1–0.2 mm long over distal $\frac{1}{2}$ – $\frac{1}{3}$; *ovules* c. 30–32; *style* c. 9–9.5 mm long, shortly eglandular setose in distal $\frac{2}{3}$; *stigma* sub-globular, c. 0.15 mm diameter. *Capsule* 3.5–4 mm long, slightly shorter than surrounding calyx, laterally compressed obloid, with rounded apex in lateral view, densely setose, with hairs 0.15 mm long, over distal $\frac{1}{3}$ of length, externally dull mid brown, internally shiny pale brown; *seeds* white, obliquely broad ellipsoid, 1.3–1.5 × 0.6–1 mm. **Fig. 1–2.**

Diagnosis. By its glabrous anther backs this new species belongs in sect. *Striatae*, but differs from most species of that section by the corolla not being prominently striated; it shares glandular hairs with *E. gibbsiae* Du Rietz, but differs by its attenuate leaf bases. Such leaf bases are



Fig. 2. Uppermost leaves, from dried herbarium specimens, of main inflorescence-bearing axes in *Euphrasia amplidens*. A–B Upper inflorescence leaves, silhouettes in actual size; C Upper pair of leaves, just below inflorescence, of showing adaxial (LHS) and abaxial (RHS) leaf surfaces. Scale bar: 0.5 mm. — A M. Wapstra & B. French s.n. (AD250975); B P. Milner 16 (AD250981); C K. Ziegler s.n. (HO566956, right hand sprig on sheet).

evident in *E. striata* R.Br., *E. fragosa* W.R.Barker and *E. semipicta* W.R.Barker, but from all of these it differs by its glandular indumentum, dense on the calyces, bracts and rachis and extending onto the leaves and branches.

Phenology. Flowering specimens have been collected in late November and early December, immature seeds in December, and capsules with mature seeds in May, but the variation in flowering and fruiting period is not known.

Distribution. At present, the new taxon is known from one historical (probably 1870s) collection of unknown provenance (simply labelled “Tasmania”) and three recent (2011/2012) collections. The recent collections are from one general area in the catchments of the Wilson and Harman rivers, in the broader Pieman River watershed, west of Tullah, in the State’s central west (Fig. 3); one site is about 1 km from the others, separated from them by a major river, while the other two are c. 500 m apart, separated by dense shrubby vegetation seemingly highly unsuitable for the species.

Habitat. No information is available on the habitat of the 1800s collection. Two of the recent sites supporting the species are very similar. Both are broad flats with impeded drainage, effectively permanently slightly inundated due to the high regional annual rainfall,

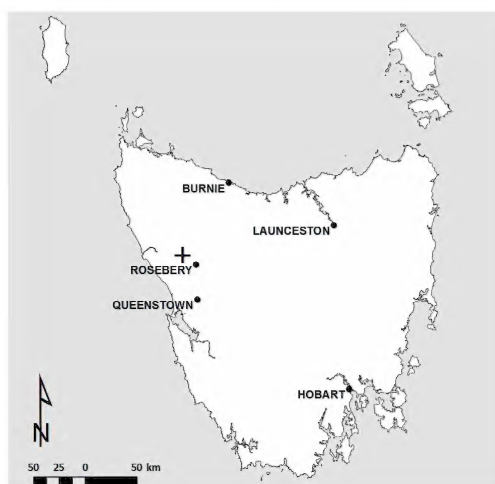


Fig. 3. Distribution of *Euphrasia amplidens* (cross).

surrounded by denser shrubby eucalypt woodland dominated by *Eucalyptus nebulosa*. Plants grow on the margins of the open sediment pans and on the edges of small slightly raised islands of heathy vegetation amongst the pans (Fig. 4–5). Associated plant species include *Leptospermum lanigerum*, *Baeckea leptocaulis*, *Sprengelia propinqua*, *Epacris glabella*, *Bauera rubioides* and *Gahnia grandis*. The third site is on the gentle slope of the ridge above one of the other sites. Here plants are growing in better drained soils, but are still in small openings in otherwise denser vegetation. Elevation varies from c. 110–120 m (sites on flats) to c. 190 m (ridge site). All sites occur on Cambrian ultramafic geology, identified on geology maps as “dominantly serpentinised layered dunite and harzburgite”.

The disturbance history of the area supporting the species is undocumented but includes some mineral extraction. Both the open sediment pan sites are on or close to old tracks and at least one appears to have been “worked over” (evidence of old mullock piles and that some of the drainage channels are the result of anthropogenic channelling). The openness of the sites is probably maintained by a combination of naturally poor drainage and fire events.

Population parameters. Based on knowledge from surveys to date, the species has an extent of occurrence of c. 43 ha, and an area of occupancy of less than 1 ha. The number of individuals at the three sites has not been formally documented: field observations indicate numbers such as 71 over c. 0.5 ha, 34 in less than 0.5 ha, 12 in c. 4 m², and c. 25 in 9 m², so that the total number of individuals is so far estimated to be less than 250.

Reservation status. The only recent collections of the new taxon are from the Meredith Range Regional Reserve, a gazetted reserve under the Tasmanian *Nature Conservation Act 2002*. The name Regional Reserve is



Fig. 4. Typical habitat of *Euphrasia amplidens* – an open sediment pan amongst otherwise dense scrubby eucalypt woodland.

applied to an area of land with high mineral potential or prospectivity and predominantly in a natural state. The purpose of such reserves is mineral exploration and development of mineral deposits, and the controlled use of other natural resources, while protecting and maintaining the natural and cultural values of that area of land.

Threats. The habitat supporting the species is subject to natural fire events that probably maintain the open gaps required for the species to persist in the absence of competition. Anthropogenic burning may be undertaken within the range of species, but is unlikely to be a threat *per se* (although undertaking such burns outside the peak flowering and fruit set period is suggested). Mineral exploration and extraction is the most likely activity to disturb populations of the species, but the impact would depend on the extent and nature of the disturbance. Further surveys would be warranted prior to any destruction of individuals or disturbance to potential habitat to ensure decisions are made in the context of the whole population.

Conservation status. Assessing the conservation status of a species represented by one historical and a single

localised contemporaneous group of collections is fraught with difficulties, but we believe a case should be presented to inform land managers with guidance on appropriate management of the new taxon. The paucity of collections is indicative of a naturally rare and restricted taxon. However, the region of its occurrence is somewhat remote and surveys are usually undertaken in response to development proposals rather than deliberately targeting potential habitat. The fact that the vascular plant species associated with ultramafic substrates in Tasmania have received considerable attention (e.g. Brown et al. 1986; Jarman & Mihaich 1991; Orchard 1991; Gray 2008), including in the west (e.g. Heazlewood Hill, Serpentine Ridge, Serpentine Hill), suggests that the lack of collections from other areas may represent a genuine geographic restriction. While further surveys in the region are undoubtedly warranted, a conservation status of Critically Endangered on the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and Endangered on the *Tasmanian Threatened Species Protection Act 1995* is suggested. Tasmania supports a suite of locally endemic taxa of *Euphrasia*, many of which are formally listed as threatened and included in the *Tasmanian lowland Euphrasia species*



Fig. 5. *Euphrasia amplidens* grows in and around the “islands” of vegetation and on the fringes of the scrub around the open sediment pans (individuals circled).

flora recovery plan (Threatened Species Section 2011), which includes relevant information on the management of locally restricted taxa.

Notes. The species was collected at some time in the 1800s, being represented in the Mueller Herbarium of the National Herbarium of Victoria (Fig. 6). The undated fragmentary collection *Scott MEL 41790* from an unknown locality in Tasmania, was noted under Sect. *Striatae* by Barker (1982, p. 107) as being remarkable for its unusually proportionate leaf apex, and a narrowly attenuate leaf base not seen in glandular hairy species of the section, being more akin to *E. striata*. “Scott” was most likely James Reid Scott (1839–1877), who arrived in Tasmania in 1856, and was a politician, surveyor, explorer and keen botanist. Between 1873 and 1876 he made various expeditions to little-explored parts of the west and southwest of Tasmania, reporting to the Minister of Lands that the area should be opened up and made accessible to encourage prospecting and mining (Smith 1976). The fact that Scott was interested in areas suitable for mining, supports the presumption that he may have collected his specimen from an area of high mineral prospectivity, such as ultramafic geology,

which expresses itself obviously in the landscape and vegetation.

Measurements of the flowers and their parts have been confined to two flowers only soaked in mild aqueous detergent, one at anthesis (the node above with flowers in mature bud) and the other clearly post-anthesis, but still attached in the calyx, together with examination of a series of flowers across the type and *Milner 16* in AD. Apart from the corolla parts, most dimensions have been checked against the dried specimens. Measurements of the capsule and seeds were made from the *Ziegler s.n.* collection in HO, which was collected 5–6 months later than the *Milner 16* and holotype material.

More collections and observations are needed to establish the full morphological variability of the species and the extent of its geographic and ecological range. Of particular interest is its relationship with serpentine soils. Tasmania supports several so-called “serpentine-endemics”, flora restricted to soils derived from ultramafic or serpentinite-bearing rocks, a globally recognised phenomenon (e.g. Anacker et al. 2011). Most notable amongst the Tasmanian examples are *Tetratheca gunnii*, restricted to a small area near Beaconsfield in the State’s northeast (Brown et al. 1986), *Micrantheum*



Fig. 6. The old Scott specimen from Tasmania in the National Herbarium of Victoria (MEL 41790), enlarged in inset (reproduced with permission from the Royal Botanic Gardens Melbourne).

serpentinum and *Epacris glabella*, both restricted to three serpentine exposures in the State's west (Jarman & Mihaich 1991; Orchard 1991), and possibly a recently described species of *Eucalyptus*, *E. nebulosa*, apparently restricted to a limited part of the Pieman River catchment on ultramafic substrates (Gray 2008). These latter three species co-occur with *E. amplidens*. Whether *E. amplidens* is another taxon wholly restricted to ultramafic substrates is not yet known; further surveys are required to document the extent of its geographic and ecological range. Discovery of novel sites will probably require considerable resources to access remote openings in otherwise virtually impenetrable scrub, but it is noted that the geological complex, with which the taxon appears to be associated, extends several kilometres to the northwest/southeast of the collection area and there appear to be numerous similar vegetation openings associated with drainage features.

Etymology. The epithet is a substantive, derived from the Latin *amplus* (large) and *dens* (tooth), alluding to the large apical leaf lobe (Fig. 2), which is unusual amongst species of *Euphrasia* in Australia and elsewhere, alluded to by Barker (1982, l.c.). A common name of **Pieman eyebright** is suggested, reflecting the distribution of the species.

Additional specimens examined

TASMANIA. West Coast region: *P. Milner* 16, Wilson River, 120 m, 28 Nov. 2011 (HO 568027, AD 250981); *Scott s.n.*, Tasmania [without locality or date] (MEL 41790); *K. Ziegler s.n.*, Wilson River, NW Tasmania, 2 May 2012 (HO 566956).

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Notes on *Hibbertia* subg. *Hemistemma* (Dilleniaceae) 9. The eastern Australian *H. vestita* group, including *H. pedunculata* and *H. serpyllifolia*

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Abstract

A taxonomic treatment of *Hibbertia* §*Vestitae* Benth. is presented. The distributions of the species range from near Hobart in Tasmania to tropical Queensland, north of Rockhampton. A key and full descriptions of all recognised taxa as well as selected illustrations are provided. The following taxa are recognised (newly described taxa and new combinations in bold): *H. basaltica* A.M.Buchanan & Schah., *H. coloensis*, *H. demissa*, *H. dispar*, *H. ericifolia* Hook.f. subsp. *ericifolia*, subsp. *acutifolia*, *H. expansa*, *H. exponens*, *H. exposita*, *H. florida* subsp. *florida*, subsp. *angustinervis*, *H. fruticosa* subsp. *fruticosa*, subsp. *pilligaensis*, *H. horricomis*, *H. intermedia* (R.Br. ex DC.) Toelken, *H. marginata* B.J.Conn, *H. mediterranea*, *H. pachynemidium*, *H. pedunculata* R.Br. ex DC., *H. porcata*, *H. samaria*, *H. serpyllifolia* R.Br. ex DC., *H. singularis*, *H. stichodonta*, *H. vestita* A.Cunn. ex Benth. var. *vestita*, var. *thymifolia* Benth.

Keywords: Dilleniaceae, *Hibbertia*, new species, nomenclature, taxonomy, eastern Australia.

Introduction

Bentham (1863) described *H. vestita* and placed it together with *H. serpyllifolia* R.Br. ex DC. and *H. pedunculata* R.Br. ex DC. in his §*Vestitae*, a validly published name without rank (cf. Toelken 2010, p.1). This concept of three species was retained until recently in spite of a call for a revision of *H. pedunculata* and *H. serpyllifolia* by Willis (1973). General use adapted the description of the species to fit local needs. Beadle (1976), for instance, described *H. pedunculata* as a “shrub to 2 m tall” but admits that “a prostrate form occurs south of the Hunter R.” referring presumably to the extremes, described here as *H. fruticosa* and true *H. pedunculata* respectively. Similarly his *H. serpyllifolia* growing on “shallow soils on granite” probably refers to *H. expansa*, while his inland form of *H. vestita* possibly also refers to *H. expansa*. He did not annotate any specimens, so that one can not be confident of his envisioned concepts, as the distinguishing characters used in the key were those used by Bentham.

The *H. vestita* group is here considered to be a natural group (cf. *Affinities*) and is easily distinguished from other groups in subg. *Hemistemma* (Touars) Horn, mainly by the stamens being arranged around the ovaries. Whilst it shares this characteristic with species of subg. *Hibbertia*, the *H. vestita* group differs in having hairy ovaries and narrow petiole bases not clasping the branches. The commonly occurring multiangular fascicled hairs in most species of subg. *Hemistemma* are here limited to a few species, and this separates the *H.*

vestita group from the *H. tomentosa* and *H. melhanioides* groups (Toelken 2010) with rosette-like fascicled hairs or scales. The *H. vestita* group is further distinguished from the very similar *H. hermanniifolia* group by the obvious protrusion of the central vein above the leaf apex, usually 3 ovaries instead of 2, and filaments are kinked below the anthers (Toelken 2012, cf. also *Affinities*) in spite of the similar staminal arrangement.

The arrangement of species in this work is alphabetical, as preliminary phenogenetic evaluations (Raheem 2012) indicate more complex relations within the group.

Characters

Many of the following characters have previously been discussed in other groups of *Hibbertia* (Toelken 1998, 2000, 2010, 2012), but are here extended and/or adapted to suit specific complications/needs, e.g. the flower stalk (cf. *Flowers*, below), in defining species of this group.

Habit. The habit of most of the species varies according to the age of the plant. The majority of species usually start as tufts of more or less erect-spreading main branches, which are, however, weak-woody so that they become decumbent or procumbent as they elongate. Some become scrambling and others may form “cushions 2’–3’ across” (e.g. *H. expansa*: J.L.Boorman NSW85887), but they usually develop a woody rootstock from which they seem to be able to regenerate after fires. Others have slender scrambling branches from a thick woody rootstock. These in turn sometimes become

woody in, for instance, *H. serpyllifolia* (e.g. plants up to 1 m high in forest; *E.R.Anderson* 3565), while most plants are only up to 50 cm tall.

Taller shrubby plants are also found in other species throughout the group, especially in *H. marginata*, *H. florida*, *H. fruticosa* and *H. coloensis*. Although they develop distinctly rigid-woody branches they usually have a more spreading than erect habit, described here as erect-spreading.

Vestiture. Hairs are an important character in the *H. vestita* group as in other groups of subg. *Hemistemma*, and can provide a convenient, reliable identification independent from flowers and other gross morphology. Hair terminology follows Toelken (2010), although the vestiture is much simpler.

Hairs in this group are commonly simple, but among them there are often some **forked hairs**, i.e. with two subequal arms. Although these could constitute fascicled hairs, it could not always be determined whether these hairs are not merely two simple hairs of neighbouring epidermal cells, since they are usually associated with more or less dense stands of simple hairs. Forked hairs usually occur rather randomly on the branches, or seem to occur geographically at random on one plant and not on others of the same species. Multiangular **fascicled hairs** have, in contrast, usually more than two arms and are specific and constant to certain parts of the morphology of plants of *H. basaltica*, *H. demissa*, *H. dispar*, *H. horricomis*, *H. samara* and *H. singularis*. They have spreading subequal to/or unequal arms.

However, the hairs on leaves, especially on the flanks of their revolute margins, present a complication of concepts as they often have one, two or rarely three usually much shorter additional arms to the longer central arm, indicating that they are fascicled hairs. These additional or smaller arms are produced only on some random leaves or local forms of the species concerned and may weather more rapidly than other hair types, so that it might not be easy to discern them as fascicled hairs after only one observation. The case for fascicled hairs is further enhanced by a ring of special epidermal cells with thickened lateral walls surrounding their base; this is here called a pustule (cf. Toelken 2012, Fig. 1; Raheem 2012, Fig. 3 & 4). These pustules are missing from the base of simple and forked hairs. Since hairs with more arms are prevalent on leaves of lushly growing branches, hairs with a pustular base and a simple arm are here interpreted as reduced fascicular hairs. These pustulate fascicular hairs occur on leaves of all species of the *H. vestita* group. Tuberculate simple hairs occur in some other species, e.g. on the calyx lobes of *H. porcata*. These hairs usually have no additional epidermal cells with thickened cell walls at their base, rather a broadened base in contrast to the multicellular pustules in fascicular hairs.

Leaves. Leaves in this group have a narrow, but thickened petiole base, similar to other species of subg.

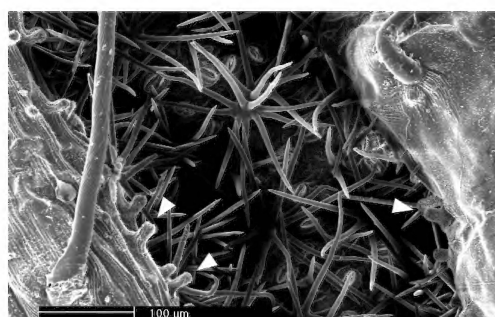


Fig. 1. *Hibbertia dispar*, abaxial leaf exhibiting teeth (arrows) on both sides of the hairy undersurface along the margins of the revolute margin and the central vein. — A.C.Beaglehole 31150.

Hemistemma, but the lamina exhibits a large range of variation in form from more or less flat to ericoid. The degree to which the central vein of the leaf is developed shows much greater variation than in other groups in the genus. For instance, in some species the central vein is scarcely thickened and the abaxial leaf surface is visible between the vein and the leaf margins, e.g. *H. marginata*, *H. serpyllifolia*, *H. vestita* and *H. coloensis*. Species with a very broad bulging central vein and the abaxial leaf surface not or barely visible are also common in the group, with extremes in *H. pachynemidium* and *H. stichodonta*. Visibility of the abaxial leaf surface between the central vein and leaf margins can sometimes be obscured or increased due to adverse environmental conditions or specimen processing. The range of variation is illustrated for *H. vestita* in Fig. 4B & C and for all species of the *H. sericea* group in Toelken (2000).

Characteristically the undersurface of the leaves is completely glabrous in most species, but in *H. basaltica*, *H. demissa*, *H. dispar*, *H. horricomis* and *H. samara*, fascicular hairs are present. Scattered simple hairs may also occur, particularly in *H. vestita*. However, in the case of species with broad central veins and tightly revolute leaf margins, hairs on the margins of the central vein and leaf margins do not fully develop and these stumps appear (when leaves are reconstituted in herbarium specimens) as rows of 'teeth' (Fig. 1, 3O), and are referred to as such in the descriptions. They are usually more visible on less rolled leaves below flowers (see also additional bracts) than on cauline leaves, particularly in herbarium specimens. They probably maintain the gas exchange to and from the stomata, which are restricted to the undersurface.

Another characteristic of this group is that the central vein is more or less protruding beyond the apex of the leaves, and is recurved in most species, giving the leaves a typically rounded apex in surface view, except for *H. expansa* and *H. fruticosa*, which usually have pointed leaves. The recurved end of the vein may appear in extreme cases like a short tail, for instance in *H. stichodonta*, particularly if it is covered by a tuft of long

hairs, as in *H. intermedia*. As the pointed vein-end of leaves is commonly recurved and the leaf apex appears blunt in surface view terminology such as cuspidate and mucronate are not used to avoid possible confusion.

Leaves, especially older ones, of species of this group are notable for their more or less spotted upper leaf surface (including the revolute margins), due to the grey appearance of the pustules or special epidermal cells surrounding the base of each of the scattered hairs (cf. *Vestiture*).

Flowers. Single flowers are usually borne terminally on main branches and this is often the end of the season's growth. Occasionally growth may continue or new growth develops sympodially the next year from the axils of the often clustered leaves below the flowers.

Flowers vary from sessile to subsessile, but there is a group of species (*H. basaltica*, *H. dispar*, *H. expansa*, *H. exponens*, *H. exposita*, *H. florida*, *H. fruticosa*, *H. intermedia*, *H. pachynemidium*, *H. pedunculata*, *H. porcata*, *H. samaria*, *H. singularis*) with more or less distinctly stalked flowers. In these species the flower stalk becomes recurved and often thickened in the fruiting stage. With such wide variation in the *H. vestita* group, evidence for the presence or absence of flower stalks often need to be sought by examining retained flower stalks at the tip of previous growth flushes of several years to be able to identify plants without flowers. Such old flower stalks are often retained for several years. Even this additional aid does not solve all problems as some species, e.g. *H. porcata* and *H. expansa* have stalked to/and sessile flowers in different populations.

This **flower stalk** is, however, difficult to define. It is neither formed by elongation of only the ultimate internode (= 'anthopodium' as in Briggs & Johnson 1979, commonly referred to as the pedicel) or the penultimate internode (= 'propodium' as described by Conn 1995, often called the peduncle). Here it is commonly developed by elongation of both internodes, although rarely by the former in *H. pedunculata*, or the latter in *H. intermedia*. Measurements for the 'flower stalk', an arbitrary term used here, refer to the length of both terminal internodes, irrespective of the position of the primary bract or additional bracts (cf. *Bracts*, below).

Bracts. In *Hibbertia* bracts are the leaf-like organs on the ultimate nodes below the flowers, but they do not always subtend the calyx as in the *H. tomentosa* group (Toelken 2010) or *H. sericea* group (Toelken 2000). This primary bract in *H. pedunculata* does not even strictly subtend the calyx. Furthermore they are not necessarily morphologically distinguishable from the leaves below. Most of the bracts are dorsiventrally flattened and the margins are flat or only weakly revolute with the central vein clearly visible. However they, and the subtending leaves, usually form a range merging into the cauline leaves. Such intermediates or bract-like leaves are referred to as additional bracts, in contrast to the distal

primary bract, and are borne on the ultimate node below the flower. Bracts usually, but not always, merge into the cauline leaves when flowers are borne on abbreviated or axillary short shoots (e.g. *H. dispar*, particularly from the Furneaux Islands). In most cases these distal axillary branchlets appear to have numerous bracts, while similar proximal branches display the usual range of morphology from the bract to the leaves. In the case of a very short branch below the flower, the additional bracts are indistinguishable from the primary bract, i.e. more than one primary bract may occur, especially when the primary bract is distinct from the additional bracts, as in, for instance, *H. exponens*. Bracts are thus here defined as the one (rarely more) **primary bract**, the ultimate leaf-like organ below the flower, being often of distinct shape and merging into subtending **additional bracts** of slightly different shape, which then usually merge into the cauline leaves below. This applies to flowers with or without more than one elongated internode below.

The concept of bracts is further complicated by the development of broader leaf-like organs below the flower (= 'hypophylls' in Briggs & Johnson 1979), which are often longer than cauline leaves, particularly in *H. vestita* var. *vestita* and var. *thymifolia*, and some species in the *H. sericea* group (Toelken 2000). As the hypophylls are often less distinct in *H. serpyllifolia*, *H. ericifolia* and *H. expansa* and also grade from the primary bract into the cauline leaves, they are here included in the concept of additional bracts.

Stamens and staminodes. Number of stamens and anther size varies greatly within and between species in the *H. vestita* group. Sometimes even sterile anthers, which appear fully developed but do not dehisce, are observed. Intermediates were not observed between sterile stamens and the staminodes, which never develop rudimentary anthers. The number of staminodes also varies greatly within and between species. Staminodes are always the same shape as normal filaments, but have a pale apex, which is not seen in damaged filaments lacking anthers, as also described for the *H. tomentosa* group (Toelken 2010). The bases of the staminodes are usually appressed to the ovary, similar to the filaments. The distal part of the staminodes recurves more or less strongly from about half way, so that they are often hidden and consequently overlooked among the large anthers when flowers are viewed from above. They are best observed in side view.

Staminodes were not observed in all species and in some species, e.g. *H. expansa*, staminodes were found only in some populations of the species. Even their number per flower varies considerably and as they are often short and difficult to assess, they were not used in delimitations of taxa. No staminodes were recorded in *H. demissa*, *H. ericifolia* or *H. horricomis*, although the flowers are in all other respects similar to those of *H. vestita*.

The bases of the filaments are usually more or less broadened and connate; this is particularly pronounced

in *H. vestita* and *H. stichodonta*, resulting in the stamens forming a ring around the ovaries. In most species, the bases of the filaments are connate into five groups, which are more or less recognisable. For instance, in *H. florida* subsp. *florida* there are three stamens between carpels and two single stamens in front of the anterior carpels (with reference to the bract). Not all stamens are regularly arranged around the ovaries, as can be observed in *H. basaltica* and *H. dispar*, where at least one group of stamens has been lost (cf. variation in *H. dispar*).

Characteristic of the filaments of the *H. vestita* group is not only their obvious broadening towards the base, but also a kink below the anthers as they curve in along the upper surface of the ovaries, but reflex immediately again to expose the anthers. The filaments sometimes do not even straighten out under the stress of the developing fruit.

Pistils. Three pistils per flower have been recorded for most species of this group. Exceptions are two in *H. basaltica*, and four or two have also occasionally been observed in a number of species, e.g. *H. pedunculata* (C.Driscoll 14).

The styles are attached to the upper outer edge of the ovaries and then usually spread centrifugally. Stigmas are often displayed at the same level as, but well outside the range of, the anthers in species of the *H. vestita* subgroup. Other species, particularly of the *H. pedunculata* subgroup, have erect styles with stigmas well above the anthers.

Fruit and seeds. The fruits of species with stalked flowers, e.g. *H. pedunculata*, are more or less recurved.

The seeds of most species are obovate but sometimes, particularly in the *H. vestita* subgroup, the attachment is shifted sideways, so that the seeds appear comma-shaped. The membranous cup of the aril is short, lobed and usually more expanded to one side.

Affinities

Bentham (1863), who was followed by most subsequent authors, placed his §*Vestitae* close to the §*Tomentosae*, which includes the *H. tomentosa* and *H. melhanioides* groups (Toelken 2010) as well as the *H. hermanniifolia* group (Toelken 2012). This was mainly based on the regular arrangement of the stamens often in five more or less distinct groups around the pistils, as opposed to a single cluster of stamens to one side of the flower. The separation of the above three groups, namely the *H. hermanniifolia* group from the *H. tomentosa* and *H. melhanioides* groups, originally shown in DNA analyses by Horn (2005, 2009), has been confirmed by different hair types. The rosette-like fascicled hairs and/or scales of the *H. tomentosa* and *H. melhanioides* groups (Toelken 2010) are distinct from multiangular fascicled hairs of the *H. hermanniifolia* group (Toelken 2012). The *H. vestita* group is here split from the former three (*H. tomentosa*, *H. melhanioides* and *H. hermanniifolia*

groups) because of its predominantly simple hairs, which are otherwise rare in subg. *Hemistemma*. Simple hairs are obviously the building blocks of fascicled hairs (Toelken 1998, Fig. 1A), which are in turn the basis of rosette-like fascicled hairs and scales, but no other connecting characters between the three groups were detected. In addition to bearing simple hairs, many species of the *H. vestita* group have a glabrous leaf undersurface, which is also unique in subg. *Hemistemma*.

Although the *H. vestita* group shares a significant character with the *H. hermanniifolia* group, i.e. apparently simple pustulate hairs on the upper leaf surface, the former group is further distinguished from the latter by predominantly glabrous undersurfaces of the leaves, the central vein obviously protruding beyond the leaf apex, filaments kinked below the anthers and broadened towards the base, the presence of staminodes and usually three ovaries instead of two.

Judging from these characters, which distinguish the *H. vestita* group not only from the *H. hermanniifolia* group, but also from other species of subg. *Hemistemma*, it is assumed here that the *H. vestita* group is a natural group of species. However, it is a group with such a widely divergent morphology that it is possible also to observe characteristics reminiscent of species in other groups in the genus. It is therefore tempting to see connections, particularly as it is obvious that in *Hibbertia*, the condition of flowers with a unilateral cluster of stamens is derived from flowers with stamens regularly arranged around the ovaries (Wilson 1965, Stebbins & Hoogland 1976, Tucker & Bernhardt 2000, Horn 2005, 2009). In fact, the change in the arrangement of the stamens to mainly on one side of the ovary, as well as the reduction of the number of pistils from three to two, is demonstrated in *H. basaltica* and *H. dispar*. Horn (2005) indicated several such changes, but due to a wide range of homoplasy in vegetative characters (Horn 2009), such apparent relationships (based on morphological observations) are not well supported in molecular analyses.

The main clusters of species within the *H. vestita* group are centred on the three species originally included by Bentham (1863) in §*Vestitae*, as outlined below, except that Bentham's concept of *H. serpyllifolia* is here referred to *H. ericifolia*:

- The ***Hibbertia vestita* subgroup** (*H. marginata*, *H. vestita*, *H. serpyllifolia*, *H. mediterranea*, *H. stichodonta*), characterised by sessile erect flowers and many staminodes, exhibits probably the most primitive characters, especially the first three species. These species have simple hairs only, more or less flat leaves (unless rolled) with glabrous undersurface and a narrow, scarcely thickened central vein, numerous stamens and staminodes, often with broadened filaments and often more than three pistils with six ovules each. *H. mediterranea* and *H. stichodonta* have ericoid leaves with much thickened central veins, but otherwise exhibit typical morphology for this group.

- The ***Hibbertia ericifolia* subgroup** (*H. coloensis*, *H. ericifolia*, *H. demissa*, *H. horricomis*) also has sessile erect flowers, but usually lacks staminodes. The margins of the leaves of *H. coloensis* and *H. ericifolia* subsp. *acutifolia* are scarcely to incompletely revolute so that the often thick central vein is quite exposed, while the other taxa have ericoid leaves. *Hibbertia demissa* and *H. horricomis*, both extremely localised, stand out in the whole *H. vestita* group by the widespread presence of fascicled hairs on most parts of the plant.
- All other species are included in the ***Hibbertia pedunculata* subgroup** (*H. basaltica*, *H. dispar*, *H. expansa*, *H. exponents*, *H. exposita*, *H. florida*, *H. fruticosa*, *H. intermedia*, *H. pachynemidium*, *H. pedunculata*, *H. porcata*, *H. samaria*, *H. singularis*) and are distinguished by a more or less developed stalked flower, which recurves in the fruiting stage ('nodding'). This is often best observed by the curved stalk retained at the end of the previous year's growth. All species have more or less well developed ericoid leaves. Most of them are decumbent except for *H. florida* and especially *H. fruticosa*, which can form shrubs up to 1.2 m tall. Simple hairs are widespread, while fascicled hairs have only been recorded for *H. basaltica*, *H. dispar*, *H. samaria* and *H. singularis*. *Hibbertia humifusa*, particularly subsp. *erigens*, shows a close resemblance to *H. samaria* (except for unilateral stamens).

Key to species and subspecies

Some characters, although discussed earlier, are here defined for quick reference in the keys. **Flower stalk** refers to two internodes below the flower. The **primary bract** is attached to the first node below the flower, while one to several **additional bracts**, similar to the primary bract, are often found on nodes below and usually grade into the cauline leaves below. The **undersurface** of leaves refers to abaxial surface, excluding the central vein, and is often more or less covered by the revolute margins. **Forked hairs** are defined as those with two arms and **fascicled hairs** with three or more often unequal arms.

1. Stamens irregularly arranged around the ovaries, with often only one stamen, or rarely none, on one side of the ovary
 2. Undersurface of leaves usually visible between central vein and revolute margins; leaves smooth; Tas. (TSE) *H. basaltica*
 2. Undersurface of leaves not visible between central vein and revolute margins; leaves with raised pustules; N.S.W. (CT); Vic. (GP, EG), Tas. (FU) *H. dispar*
1. Stamens in regular groups arranged around the ovaries
 3. Flower stalks > 4 mm (rarely some shorter) and recurved to nodding in the fruiting stage (examine hooked flower stalks of previous year on lower branches)
 4. Outer calyx lobes obtuse to rounded and without distinct central ridge
 5. Spreading hairs on leaves (0.4–) 0.5–0.7 mm long; central vein \pm flush with revolute margins, but undersurface of leaves often visible between them; Qld (DD), N.S.W. (NT) *H. expansa*
 - 5: Spreading hairs on leaves (0.15–) 0.2–0.3 (–0.4) mm long; undersurface of leaves not visible and with blunt papillae on opposite margins; N.S.W. (NC, CC, ?CWS) *H. pedunculata*
 - 4: Outer calyx lobes acute or pointed and with well developed central ridge towards the apex
 6. Branches covered with multiangulate fascicled hairs; simple hairs present or absent
 7. Anthers 0.9–1.2 mm long; central vein of leaves flush with or bulging above revolute margins; NSW (ST) *H. singularis*
 - 7: Anthers 1.5–2 mm long; central vein of leaves recessed below revolute margins; Vic. (EHL) *H. samaria*
 - 6: Branches covered with short and long simple, rarely forked hairs
 8. Primary bracts subtending or close to the calyx
 9. Simple hairs on branches porrect; leaves densely hairy; Qld (DD), N.S.W. (NT) *H. expansa*
 - 9: Simple hairs on branches antrorse to \pm appressed; leaves with scattered hairs often wearing off
 10. Shrublets 0.1–0.4 m high, with decumbent to prostrate wiry-woody branches; N.S.W. (NWS) *H. florida* subsp. *florida*
 - 10: Shrubs 0.4–1.2 m tall, with erect-spreading branches becoming rigid-woody
 11. Leaf apex distinctly cuspidate; N.S.W. (NWS) *H. fruticosa* subsp. *fruticosa*
 - 11: Leaf apex hardly mucronate
 12. Leaves glabrescent, undersurface not visible; N.S.W. (NWP) *H. fruticosa* subsp. *pilligaensis*
 - 12: Leaves hairy (scabrid), undersurface usually visible between central vein and revolute margins; NSW (NWS) *H. florida* subsp. *angustinervis*
 - 8: Primary bracts below the middle of the flower stalk
 13. Outer calyx lobes hirsute to strigose, distal margins usually recurved; N.S.W. (CT, ST, SWS), Vic. (MID) *H. porcata*
 - 13: Outer calyx lobes glabrescent or rarely hairy (pubescent), distal margins not or scarcely recurved
 14. Central vein of leaves broader than, and bulging to flush with, revolute margins, with undersurface not visible between them
 15. Filaments strap-like; leaves with bulging pustules; flower stalk (2–) 3.5–5 (–9.5) mm long; N.S.W. (ST) *H. pachynemidium*
 - 15: Filaments filiform; leaves smooth with flat pustules; flower stalk (5.6–) 8–15 (–18.5) mm long; Vic. (EHL) *H. exposita*

- 14: Central vein of leaves \pm as broad as, and recessed from, the revolute margins, with under-surface often visible between them
- 16: Flower stalk 2–5 mm long; anthers 1.6–1.8 mm long; N.S.W. (CT, CC) *H. intermedia*
- 16: Flower stalk (4.5–) 5–7.5 (–11.3) mm long; anthers 0.5–1.4 mm long; Vic. (EG) *H. expensis*
- 3: Flowers sessile (flower stalk < 4 mm), remaining erect in the fruiting stage
- 17: Branches covered with multiangular fascicled hairs, simple hairs present or absent
- 18: Leaf lamina (1.2–) 1.4–1.8 (–2.2) mm long; decumbent shrublet rarely to 15 cm tall; N.S.W. (NT) *H. demissa*
- 18: Leaf lamina (2.4–) 3.5–6.5 (–9.2) mm long; erect-spreading shrublet to 30 cm tall; N.S.W. (ST) *H. horricomis*
- 17: Branches covered with simple and rarely forked hairs
- 19: Leaf lamina \pm evenly recurved along its length, (1–) 2–3 (–3.5) times longer than broad; branches twisted and curved; Qld (MO), N.S.W. (NC) *H. vestita* var. *thymifolia*
- 19: Leaf lamina straight or rarely petiole recurved, (3–) 5–8 (–12) times longer than broad, branches usually straight
- 20: Outer calyx with fine, often sparse hairs (sericeous)
- 21: Shrubs (0.5–) 0.8–2 m tall, few stemmed
- 22: Outer calyx lobes (9.7–) 10–12 (–13.8) mm long; leaf lamina (7.6–) 8–13 (–15.8) mm long; N.S.W. (CC) *H. coloensis*
- 22: Outer calyx lobes (4.2–) 5.5–7.5 (–8.4) mm long; leaf lamina (2.6–) 4–8 (–9.6) mm long
- 23: Anthers (1.8–) 2–2.2 mm long; undersurface of leaves usually visible between central vein and revolute margins unless leaf tightly rolled; Qld (PC) *H. serpyllifolia*
- 23: Anthers 1.1–1.6 mm long; undersurface of leaves not visible between central vein and revolute margins; N.S.W. (NWP, NWS) *H. fruticosa* (for subspecies see lead 11)
- 21: Shrubs 0.2–0.4 m tall, multistemmed
- 24: Anthers (1.8–) 2–2.2 mm long; Qld (PC) *H. serpyllifolia*
- 24: Anthers 0.8–1.6 mm long
- 25: Stamines several to many; prostrate to mat-forming; N.S.W. (ST) *H. pachynemidium*
- 25: Stamines absent; decumbent to erect-spreading
- 26: Primary bracts linear-lanceolate to linear-elliptic, (1.3–) 1.5–2.5 (–3.6) \times 0.1–0.4 mm; leaf apex blunt with end of vein \pm reflexed; N.S.W. (CT, CC, ST, SC), Vic. (EHL, EG), Tas. *H. ericifolia* subsp. *ericifolia*
- 26: Primary bracts lanceolate to spatulate, (3.2–) 5.5–7 (–7.8) \times 1.3–2.3 mm; leaf apex pointed to acute, rarely slightly recurving; N.S.W. (CC, ST, SC) *H. ericifolia* subsp. *acutifolia*
- 20: Outer calyx with coarse, often dense hairs (hirsute to strigose)
- 27: Central vein at mid-leaf broader than, and usually tightly wedged in between, the revolute margins; if vein terminally protruding then with short tuft of hairs on young leaves; N.S.W. (CT, ST, SWS), Vic. (MID) *H. porcata*
- 27: Central vein at mid-leaf narrower, or as broad as and separate from the revolute margins, unless tightly rolled; if vein terminally protruding then with long obvious tuft of hairs
- 28: Leaves usually pointed; central vein, if protruding beyond leaf apex, straight; inland Qld (DD), N.S.W. (NT) *H. expansa*
- 28: Leaves obtuse to rounded; central vein, if protruding beyond leaf apex, recurved; coastal to eastern foothills of the Great Dividing Range
- 29: Calyx lobes (5.2–) 6–8 (–9.8) mm long; leaf lamina (2.2–) 3.5–8 (–11.4) mm long; Qld (MO, WB); N.S.W. (NC) *H. vestita*
- 29: Calyx lobes 12–20 mm long; leaf lamina 10–40 mm long; N.S.W. (NC) *H. marginata*

Taxonomy

Species are arranged alphabetically as relations appear to be even more complex than the three subgroups of species cited under *Affinities* (above). Regional codes are the ones used in State floras of Qld, N.S.W., Vic. and Tas.

Hibbertia basaltica A.M.Buchanan & Schah.

Muelleria 22: 105 (2005); A.M.Gray, Fl. Tasman. Online, Dilleniaceae (version 2009: 2) 3 (2009). — **Type:** Tasmania, Ford Road, Pontville, *A.M.Buchanan s.n.*, 8.x.2004 (holo.: HO527774; iso.: AD – n.v.).

Shrublet prostrate to procumbent, moderate to much branched; branches wiry and up to 40 cm long, with shallow decurrent leaf bases, sparsely hirsute. *Vestiture* persistent, usually without obvious basal tubercles or pustules, with \pm dense fascicled hairs overtopped by

usually few longer antrorse simple hairs; *on branches* usually dense, with a range of longer and shorter multiangular fascicled hairs ((3–) 5–7 often unequal arms) overtopped by scattered to very few spreading simple hairs; *on leaves above* with scattered antrorse simple or rarely forked hairs without protruding pustules, sometimes longer and ciliate on the flanks of the revolute margins over smaller antrorse multiangular fascicled hairs (3 (–5) unequal arms) towards and on the margins; *on leaves below* with scattered antrorse simple over mainly shorter antrorse fascicled hairs on the revolute margins and the central vein but exposing between the two dense short multiangular fascicled hairs on the undersurface, with a tuft of simple hairs on the end; *on primary bracts* similar to leaves above and below with mainly fascicled hairs overtopped by

± simple hairs; *on outer calyx lobes* outside with few to many antrorse fascicled hairs overtopped by few scattered simple hairs mainly distally especially on terminal point, inside moderately dense mainly forked and fascicled antrorse appressed hairs; *on inner calyx lobes* outside dense, with mainly spreading multiangular fascicled hairs (5–12 subequal arms) overtopped by a few antrorse simple hairs along the central ridge, inside sparse, with a cluster of fine mainly forked hairs below the apex. *Leaves* with intrapetiolar tuft of hairs up to 0.7 mm long, extending laterally along the leaf bases; *petiole* up to 0.3 mm long, often indistinct; *lamina* linear to linear-elliptic, (2.4–) 3.5–6 (–7.4) × 1–1.4 (–1.6) mm, gradually constricted into petiole, acute to obtuse and with terminal tuft of hairs, above convex or slightly depressed along the central vein, puberulous to glabrescent, below with recessed broad central vein often not touching the puberulous revolute margins and thus exposing rows of teeth or the tomentose undersurface between them. *Flowers* single, terminal mainly on main branches; *flower stalk* (4–) 6–14 (–20) mm long, with primary bract below the middle; *buds* narrowly ellipsoidal; *primary bracts* linear-lanceolate, (2.3–) 2.5–3 (–3.6) × 0.3–0.5 mm, with tufted pointed apex usually recurved, dorsiventrally compressed but with revolute margins, sparsely tomentose, additional bracts absent. *Calyx lobes* unequal; *outer calyx lobes* lanceolate, rarely elliptic, 4.5–4.7 (–5.1) × 2.3–2.5 mm, slightly longer than the inner ones, pointed with terminal tuft, ± distinctively ridged, outside pubescent to sparsely hirsute, inside pubescent on distal half; *inner calyx lobes* ovate, 4.3–4.7 (–4.8) × 2.5–2.8 mm, pointed with terminal tuft, scarcely ridged, outside pubescent, inside glabrous. *Petals* obovate, up to 10 mm long, bilobed. *Stamens* (3–) 4 or 5 (–7) on one side and 1 in front of the ovaries, staminodes absent; *filaments* filiform, 1.4–1.6 mm long, slightly broadened basally and connate in groups; *anthers* narrowly obloid, 1–1.2 mm long, above abruptly constricted and below tapering into filament. *Pistils* 2; *ovaries* obovoid, each with 4 (–6) ovules, shortly pubescent to tomentose; *styles* attached to the outer upper margins of the ovaries then erect with stigmas above the anthers. *Fruit* recurved, fascicled-tomentose. *Seeds* obloid-obovoid, rarely obovoid, 1.6–2 × 1.2–1.5 mm, brown to dark brown; aril with fleshy attachment usually basal or slightly oblique, surmounted by a lobed membranous cup covering the lower third of the seed. *Flowering*: September–November.

Common name: Basalt guinea flower (Buchanan & Schahinger 2005; Gray 2009).

Distribution and ecology. Plants are “associated with rocky basalt outcrops on slopes above the Jordan River” where the “native grassland is dominated by *Themeda triandra* Forssk. and *Austrostipa* spp. with the occasional tall shrub of *Bursaria spinosa* Cav.” in southern Tasmania (TSE) (Buchanan & Schahinger 2005).

Conservation status. Buchanan & Schahinger (2005) after detailed observation of the eight known populations gave the species a 2ECi listing (Briggs & Leigh 1996).

Diagnostic features. Shares with the very similar *H. dispar* a zygomorphic arrangement of the stamens, which distinguishes them from other species of the *H. vestita* group. *H. basaltica* differs by its distinct flower stalk up to 20 mm long, the predominance of fascicled hairs on the outer calyx lobes, the leaves without obvious pustules to the hairs and the central vein not being wedged tightly between the revolute margins, so that the fascicled-tomentose undersurface is often visible. The earliest specimen of this species, collected in 1898, was identified as *H. empetrifolia*, but this record was never published. *H. basaltica* is distinguished by the absence of hooked simple hairs on the undersurface of leaves and the presence of an odd single stamen on the opposite side from the cluster of stamens on one side of the ovaries.

Variation. The number of simple hairs on branches and calyx vary much from one plant to another but the usually dense cover of longer and shorter fascicled hairs is diagnostic for the species.

Specimens examined

TASMANIA: *A.M.Buchanan* 5664, 2 km W Richmond, 17.ii.1985 (HO); *P.Collier* 5302, 2 km W Richmond, 10.xi.1991 (HO); *F.A.Rodway* NSW86687, Jordan River, ix.1898 (NSW).

Hibbertia coloensis Toelken, sp. nov.

A speciebus turmae *H. vestitae foliis longioribus glabrescentibus quoque nervo centrali angusto late separato a marginibus revolutis differt.*

Type: New South Wales, Wollemi National Park, Colo River, *P.H.Weston* 3392, 18.x.2008 (holo.: AD; iso.: NSW; NE – n.v.).

Shrubs up to 1.5 m tall and 2 m in diameter, much branched; branches with distinct decurrent leaf bases, but not flanged, hirsute to strigose mainly along the grooves between leaf bases. *Vestiture* persistent to glabrescent, longer usually over shorter simple hairs; *on branches* moderately dense with long straight antrorse ± appressed simple hairs mainly along the grooves overtopping short spreading simple or rarely forked ones; *on leaves above, below and on bracts* scattered short antrorse simple hairs but usually worn off when leaves are fully developed except for a few hairs on the adaxial petiole and adjoining proximal lamina, but some flat pustules may be visible particularly distally; *on outer calyx lobes* outside with scattered to sparse long antrorse-appressed simple hairs particularly along the central ridge and the margins, inside moderately dense with longer and shorter appressed simple, rarely forked hairs on at least the distal half; *on inner calyx lobes* outside, moderately dense to dense, mainly with long coarse hairs along the centre, becoming shorter towards the membranous margins, inside a cluster of fine, often forked hairs below the apex. *Leaves* with intrapetiolar

tufts of hairs up to 1 mm long and becoming denser and decurrent along the grooves on either side of the leaf bases; *petiole* 0.3–0.7 mm long, often indistinct; *lamina* linear to linear-oblancoate, (7.6–) 8–13 (–15.8) × (0.8–) 1.2–1.6 mm, very gradually tapering into petiole, acute to cuspidate with ± straight, puberulous to glabrescent end of central vein overtopping the leaf apex, above flat and slightly grooved along the central vein, glabrous or proximally puberulous, below narrow revolute margins distinctly separated from raised but not broad central vein by the glabrous undersurface, which is becoming broader on leaves below the flowers, glabrescent except for puberulous vein apex. *Flowers* single, sessile or subsessile, terminal on terminal and axillary branches; *flower stalk* 0–4 mm long; *buds* obloid-ovoid; *primary bracts* oblong-elliptic to oblong-lanceolate, 7–7.8 × 1.7–2.2 mm, pointed to cuspidate, flat with scarcely recurved margins and faintly raised vein, glabrous; additional bracts 1–3, with ± revolute margins, merging into cauline leaves. *Calyx lobes* unequal; *outer calyx lobes* lanceolate, (9.7–) 10–12 (–13.8) × 4–4.6 mm, longer than inner ones, acute, slightly ridged towards the apex, outside sericeous particularly toward the base, inside with scattered hairs towards the distal margins; *inner calyx lobes* obovate to oblong-obovate, (6.5–) 6.8–7.5 × 5.5–6.2 mm, rounded to emarginate, outside shortly sericeous becoming pubescent towards the glabrous membranous margins, inside glabrous or puberulous subterminally. *Petals* obovate, up to 14 mm long, ± bilobed. *Stamens* 24–26 (–30), without staminodes, surrounding the ovaries; *filaments* filiform, 1.3–1.6 mm long, ± broadened and scarcely connate basally; *anthers* slender-obloid, 1.3–2.2 mm long, gradually tapering into petioles, abruptly constricted above. *Pistils* 3; *ovaries* ovoid, each with 6 ovules, hirsute; *style* attached to the outer upper apex of ovaries, erect, with stigmas well above the apex of the anthers. *Fruit* and *seed* not seen. *Flowering*: October.

Distribution and ecology. Apparently restricted to the Colo River, Wollemi National Park in New South Wales (CC) where it grows in sand among sandstone boulders along the creek, c. 1 m above the water level, but well into the flood zone, on edge of stunted *Tristaniopsis laurina* woodland.

Conservation status. Although the species is known only very locally and conserved in Wollemi National Park, it is described as “locally frequent” (A.N.Rodd 11203).

Diagnostic features. The long, stiffly-erect leaves, primary bracts and calyx lobes easily distinguish this species from others in this group. Although the scarcely recurved leaf margins expose much of the glabrous undersurface, reminiscent of those of species of the *H. vestita* subgroup, the usual absence of staminodes places this species into the *H. ericifolia* subgroup.

Variation. Fruiting specimens have distinctly accrescent calyx, which is unusual in the *H. ericifolia* subgroup.

Etymology. As the species was only found along the Colo River the Latin suffix “-ensis” part of the epithet “coloensis”, indicates the origin of the species.

Specimens examined

NEW SOUTH WALES: A.N.Rodd 11203, Colo River, 24.x.2004 (NSW).

Hibbertia demissa Toelken, sp. nov.

A speciebus turmae H. vestitae pilis radiale fasciculatis in ramis, habitu demisso, foliis brevissimis elliptico-oblongis nervis centralibus marginibus revolutis duplo latioribus differt.

Type: New South Wales, top of range near Backwater, J.A.Blakeley, E.N.McKie & T.Boorman NSW85822, 30.x.1929 (holo.: NSW).

Shrublets up to 0.15 m tall, much branched, decumbent; branches wiry-woody becoming rigid-woody basally, with leaf bases shortly decurrent, sparsely tomentose. *Vestiture* ± persistent, with multiangulate fascicled and/ or simple hairs on different organs; *on branches* moderately dense, with spreading multiangulate fascicled hairs (3–6 subequal, rarely unequal arms) or antrorse simple hairs part of the decurrent intrapetiolar tufts; *on leaves above and below* with scattered stiff simple or forked (rarely fascicled with 3 or 4 arms) hairs each on a prominent pustule, often somewhat larger on the flanks of the revolute margins, but without pustules in dense tufts on adaxial petiole, with dense fine fascicled hairs from the undersurface often showing and very short hairs on short terminal end of central vein; *on primary bracts* sparse, with simple and forked hairs but without pustules; *on outer calyx lobes* outside sparse to moderately dense, with larger coarse antrorse simple or rarely forked hairs without pustules over very dense, almost erect simple hairs and often with marginal cilia, inside sparse, with few short appressed simple hairs; *on inner calyx lobes* outside moderately dense, with coarser antrorse-appressed simple hairs over few shorter ones extending towards the membranous margins, inside glabrous except for a cluster of short antrorse-appressed simple hairs below the apex. *Leaves* with dense intrapetiolar tufts up to 0.3 mm long and shortly decurrent on both sides of the leaf bases; *petiole* 0.05–0.4 mm long, usually distinct; *lamina* elliptic-oblong, (1.2–) 1.4–1.8 (–2.2) × 1.4–1.7 mm, usually abruptly constricted into petiole, obtuse, with central vein scarcely overtopping the apex and with very short terminal tuft of hairs, above ± flat with scattered prominently pustulated hairs, below with broad central vein flush with, c. twice as broad as, and tightly wedged in between, the revolute margins, covered with scattered tubercled hairs, erect to spreading at right angles to the branches when older. *Flowers* single, terminal on main branches; *flower stalk* absent, *buds* ellipsoidal; *primary bracts* lanceolate, c. 5.4 × 1.6 mm, pointed, scarcely ridged, sparsely pubescent; additional bracts absent. *Calyx lobes* unequal; *outer calyx lobes* lanceolate, 4.5–5.6 × 1.6–1.8 mm, acute, scarcely

ridged, outside pubescent, inside puberulous on distal third; *inner calyx lobes* oblanceolate to oblanceolate-elliptic, $5.6\text{--}6 \times 2\text{--}2.3$ mm, obtuse, not ridged, outside strigose-pubescent, inside puberulous below the apex. *Petals* broadly obovate, c. 7 mm long, bilobed. *Stamens* 9–12, without staminodes, around the ovary; *filaments* filiform, 1.4–1.6 mm long, scarcely connate basally; *anthers* slender obloid, 1.7–2 mm long, abruptly constricted above, gradually tapering into filaments. *Pistils* 3; *ovaries* obovate, each with 4 ovules, pubescent below and hirsute above; *style* attached to the outer upper edge of the ovary, then slightly curved and erect in between the anthers with stigmas well above them. *Fruit* and *seeds* not seen. *Flowering*: October.

Distribution and ecology. Grows localised on sandy soil above granite in forest of *Eucalyptus acaciiformis* and *E. dalympleana* in north-central New South Wales (NT).

Conservation status. Of unknown frequency and the presently known localities are outside any conservation reserves.

Diagnostic features. The diminutive *H. demissa* resembles superficially another small and as yet undescribed *Hibbertia* species from the Warrumbungle Range, but differs by antrorse simple to fascicled hairs on the leaves and the stamens arranged around the ovaries.

Etymology. The habit of this shrublet is “low and humble”, Latin “demissa”, as reflected in the epithet.

Specimens examined

NEW SOUTH WALES: *D. Verdon* 261, Pheasant Mountain, 1.ix.1969 (CANB); *J.B. Williams* NE30603a, E Backwater, 11.iii.1971 (NE); *H.J. Wissmann* NE45216A, Pheasant Mountain, Backwater, 5.iii.1967 (NE).

Hibbertia dispar Toelken, sp. nov.

Hibbertiae basalticae similis sed floribus pedunculatis, pilis praecipue simplicibus in lobis calicis foliisque pilis manifeste tuberculatis; a speciebus aliis turmae *H. vestitae* staminibus anterioribus deminutis differt.

Type: Victoria, Valencia Creek Road, A.C. Beauglehole 43441, 30.x.1973 (holo.: CANB; iso.: MEL, NSW).

Hibbertia pedunculata auctt. non R.Br. ex DC.: J.H. Willis, Handb. Pl. Victoria 2: 386 (1973), p.p.; Toelken in N.G. Walsh & Entwistle, Fl. Victoria 3: 304 (1996), p.p.; N.G. Walsh & V. Stajsic, Census Vasc. Pl. Victoria ed. 8: 79 (2007), p.p.

Shrublets rarely taller than 0.2 m, prostrate to decumbent; moderately to much-branched; branches wiry or rarely becoming rigid-woody, up to 30 cm long, with leaf bases scarcely decurrent, hirsute to pubescent. *Vestiture* persistent, with usually distinctly longer spreading simple hairs overtopping short simple, forked and/or fascicled hairs; *on branches* ± dense with long spreading ± antrorse simple hairs overtopping short simple or forked and/or fascicled hairs, rarely only short fascicled hairs; *on leaves above* scattered, with antrorse simple hairs, usually obviously pustulate, becoming

longer on the flanks of the revolute margins; *on leaves below* scattered, with tubercled antrorse simple hairs on the revolute margins and the central vein and between the latter two ridges often with rows of teeth but undersurface not visible, with terminal point of central vein recurved and tufted; *on primary bracts* sparsely hairy similar to the leaves but mainly towards the apex; *on outer calyx lobes* outside, usually moderately dense, with spreading simple hairs overtopping few forked and/or fascicled hairs mainly proximally, inside sparse, with mainly appressed simple hairs on the distal third; *on inner calyx lobes* outside, with sparse shorter simple hairs mainly along the central ridge and with usually sparse to moderately dense, rarely few forked hairs towards the sides, inside with a cluster of very short simple hairs below the apex. *Leaves* with intrapetiolar tufts of hairs up to 0.6 mm long, scarcely elongating below flowers and usually decurrent along both sides of the leaf bases; *petiole* 0.2–0.6 mm long; *lamina* linear, (1.8–) 2.5–6.5 (–10.4) × (0.8–) 1–1.3 mm, ± abruptly constricted into the petiole, acute and with recurved tufted end of vein, becoming obtuse, above ± flat, sparsely pubescent to glabrescent but with obvious pustules, below with broader central vein flush or recessed to and tightly wedged between the revolute margins, similarly sparsely pubescent to glabrescent (but with pustules) as above and sometimes with a row of teeth between the revolute margins and the central vein. *Flowers* single, terminal on main as well as on short lateral branches, with narrow angular base; *flower stalk* (0–) 2–4 (–6) mm long, with primary bract on the lower third; *buds* narrowly ovoid to ellipsoidal; *primary bracts* linear to linear-lanceolate, (0.8–) 1.2–2.4 × 0.2–0.35 mm, long, flattened to leaf-like, with distinctly recurved margins, fleshy, usually with tuft of simple hairs towards the apex grading into cauline leaves, or with 1–4 additional bracts usually merging into cauline leaves but not at base of axillary short shoots. *Calyx* lobes subequal; *outer calyx lobes* lanceolate to lanceolate-elliptic, (5.2–) 5.4–5.8 (–6.1) × 1.8–2.6 mm, acute, with central ridge ± well developed, outside pubescent to puberulous, inside glabrous to puberulous on distal third; *inner calyx lobes* elliptic-obovate, (5–) 5.2–5.6 (–6) × 2.6–3.2 mm, rounded, outside pubescent to sparsely tomentose, rarely glabrescent, inside glabrous. *Petals* cuneate-oblanceolate to obovate, rarely longer than 7 mm, usually bilobed. *Stamens* (2–) 4–6 (–9), usually most of them on one side and (0) 1 (2) on the other side of the ovaries, without staminodes; *filaments* filiform, 1.2–1.5 mm long, not or scarcely connate basally; *anthers* broadly obloid, (1–) 1.1–1.4 mm long, verruculose-papillate, above abruptly constricted, below ± tapering into filaments. *Pistils* 2; *ovaries* obovoid, each with (2–) 4 ovules, tomentose, rarely hirsute; *style* attached to the outer edge of the apex of the ovaries, then curved outwards and up and then incurved with the terminal stigmas above the anthers. *Fruit* recurved, with fascicled hairs. *Seeds* obloid-obovoid to obloid-comma-shaped, 1.7–2 × 1.4–1.6,

brown; *aril* with fleshy oblique attachment surmounted by lobed membranous cup or only usually two lobes covering the lower third of the seed. *Flowering*: (July) September–November (January). **Fig. 1.**

Distribution and ecology. Grows in a wide range of habitats: usually found on rocky slopes often along creeks in sclerophyll vegetation in New South Wales (CT), Victoria (GP, EG), or grows on flats in scrub dominated by *Melaleuca gibbosa*, as recorded from Cape Barren Island, Tasmania (FU). Plants from Flinders and Clarke Island, Tasmania (FU) are recorded from wet areas near a lagoon or in sedgeland on marshy flats.

Conservation status. Known mainly from localised occurrences, some of them conserved in Croajingolong National Park, and recorded from Flinders Island (*P. Collier* 4908) as “locally common”.

Diagnostic features. *Hibbertia dispar* is very similar to *H. basaltica*, as it also has a zygomorphic androecium, but the former species differs by possessing distinctly pustulate fascicled hairs with a single arm on the leaves, by the undersurface of leaves not being visible, subsessile flowers with a flowering stalk, usually less than 4 mm long, and the predominance of spreading simple hairs on the outer calyx. *Hibbertia dispar* and *H. basaltica* are also geographically well separated and occupy different habitats.

Hibbertia dispar closely resembles many other species of the *H. pedunculata* subgroup, in its decumbent habit, its production of most flowers on short lateral shoots and the characteristic hairs tufts at the end of young leaves and bracts. *Hibbertia dispar* and *H. basaltica* stand out in this group and are easily distinguished by their few and zygomorphically arranged stamens.

Hibbertia dispar is sometimes confused with *H. empetrifolia*, but can be distinguished by the strongly revolute leaf margins (usually touching the broad central vein, thereby obscuring the leaf undersurface) and its characteristic staminal arrangement.

Variation. The length of the anthers varies considerably as is often the case in other species of the *H. pedunculata* subgroup and occasionally vestigial (non-dehiscent) anthers occur, but staminodes were not observed in *H. dispar* or the related *H. basaltica*.

The gynoecium and especially the androecium of these two species have been much modified from the 5-merous condition. While the three ovaries common to other species in the *H. vestitata* group are more or less arranged in a triangle, the two ovaries of *H. dispar* and *H. basaltica* are aligned more or less opposite to one another with the styles attached to the upper outer opposite sides. The stamens, which are borne in fives and often more or less distinguishable around the ovaries in other species of the *H. vestitata* group, occur in these two species in two clusters on opposite sides of the gap between the two ovaries. On one side of the ovaries is a single stamen (rarely 0 or 2) and on the opposite

side of the same gap are (2) 3 or 4 (5) stamens closely grouped in *H. dispar*. This bigger cluster has commonly one separate single stamen on either side, but one or both are sometimes absent, so that at times only 1 out of 4 potential groups of stamens (or out of normally 5, as in other species of the *H. vestitata* group) are represented in *H. dispar*. In one flower of a specimen examined, *C. Burgess* 12511, three pistils were present and two single stamens were alternating with them on the one side and another single one on the one side of a group of two clustered occurred. These variations observed in *H. dispar* and a similar reduction known from *H. basaltica*, could present a developmental link from flowers of the *H. vestitata* group with usually 3 ovaries and 5 groups of stamens to 2 ovaries and 1 group of stamens in most species of the subg. *Hemistemma*.

Hibbertia dispar also shows some interesting local variation. The single stamen opposite the remaining stamens is missing from most flowers examined of plants from Flinders and Clarke Island, but it is regularly present on specimens from Cape Barren Island, the island situated between Flinders and Clarke Islands. All plants from the Furneaux Islands are distinguished from the mainland form, as well as from *H. basaltica*, by the absence of simple hairs on the internodes of the branches, but this is not an easy character to use as simple hairs usually wear off very soon. Although Buchanan & Schahinger (2005) state that simple hairs may be rare on branches in *H. basaltica*, the fascicled hairs on internodes in *H. dispar* from the Furneaux Islands are few and scattered. In addition *H. dispar* has always only simple hairs on the leaves.

The three known populations of *H. dispar* from the mainland, although disjunct, are remarkably uniform, except for longer simple hairs in New South Wales and central Gippsland as compared to plants from eastern Gippsland. However, the length of the simple hairs on leaves and calyces varies from up to 0.4 mm in East Gippsland to 0.7 mm in central Gippsland, with intermediates found in each population. The calyx hairs on some plants from Eastern Gippsland are noticeably long on flowers which have developed into galls (e.g. *D.E. Albrecht* 4880). Such plants have usually a number of sessile flowers in terminal clusters with a thickened stalk in between.

Flowers of specimens from the mainland are usually borne terminally on all well developed branches, but on plants from the Furneaux Island axillary branches are often so much reduced that they could be called fascicled and the lower leaves (= additional bracts) are not fully developed and often more or less compressed. This reduction does not seem to be a reflection of the condition under which the plants were growing, as flowers are subsessile on *P. Collier* 3582 and distinctly stalked on *J.S. Whinray* 13243. It is also important to note that all flowers, whether sessile or stalked, are nodding in the fruiting stage, similar to *H. expansa*. This is an important diagnostic character of the *H. pedunculata* subgroup.

Etymology. The frequent occurrence of fascicled hairs, subsessile flowers and, most importantly, the zygomorphic androecium of this species are more reminiscent of species of the *H. stricta* or *H. cistoidea* groups. The epithet “dispar”, Latin “unlike”, refers to these unusual characteristics within the *H. vestita* group.

Specimens examined

NEW SOUTH WALES: *C.Burgess CBG12511*, Paddys River, 11.xi.1961 (CANB); *P.Gilmour 1138*, Impressa Moor, Nadgee Nature Reserve, 10.ix.1983 (CANB); *R.T.Miller s.n.*, 0.5 km S of Penrose Rest area, along western boundary track, Penrose State Forest, 12.x.2010 (AD, NSW).

VICTORIA: *D.E.Albrecht 4880*, Genoa River, c. 1 km downstream from Tasker track crossing, 24.x.1991 (MEL); *R.J.Bates 10636*, Malacoota, x.1987 (AD); *A.C.Beaglehole 31150*, c. 8 miles [12.8 km] NNE Seal Creek Mouth, 10.x.1969 (CANB, MEL); *A.C.Beaglehole 33698*, near junction of Sarah Allens Track and Wangarabell Road, 10.viii.1970 (MEL); *A.C.Beaglehole 35020 & K.C.Rogers*, Upper Genoa River, 30.xi.1970 (MEL); *A.C.Beaglehole 37167*, Bowen Range, Mt Bowen area, 4.iii.1971 (CANB, MEL, NSW); *A.C.Beaglehole 37419*, Lizzie Ward Road, Nicholson River, 15.iii.1971 (CANB, MEL); *A.C.Beaglehole 37491*, Sandy Creek, Tabberabbera Road, 19.iii.1971 (MEL, NSW); *A.C.Beaglehole 67565*, 15 km S Tubbut PO, 22.i.1980 (MEL); *R.A.Kilgour 40*, Briagolong, junction of Freestone and George creeks, 12.ix.1981 (MEL); *R.A.Kilgour 319*, Mc Kinnon Point, c. 13 km NNE Briagolong, 25.x.1982 (MEL); *N.A.Wakefield 2509*, Genoa River, Wangarabell, iii.1948 (MEL); *N.A.Wakefield & J.H.Willis MEL35579*, Genoa Gorge, 23.x.1948 (MEL); *N.G.Walsh 6118*, Dartmouth Road, 3.75 km from Omeo Hwy, 13.x.2004 (MEL).

TASMANIA: *J.B.Cleland NSW230570*, Launceston, xi.1911 (NSW); *P.Collier 3582*, W Devils Chimney, Cape Barren Island, 9.x.1988 (HO); *P.Collier 4908*, 3 km NE Mt Leventhorpe, Flinders Island, 28.x.1990 (HO); *J.S.Whinray 66*, Clarke Island, 27.xii.1966 (MEL); *J.S.Whinray 306*, Cape Barren Island, 31.xii.1969 (MEL); *J.S.Whinray 357*, Cape Barren Island, 20.xi.1969 (MEL); *J.S.Whinray 1693*, Clarke Island, 26.ix.1976 (MEL); *J.S.Whinray 2264*, near McLaines Bay, Clarke Island, 7.xi.1979 (MEL); *J.S.Whinray 2305*, near Sandy Lagoon, Clarke Island, 9.xi.1979 (MEL); *J.S.Whinray 2354*, flat south of Sandy Lagoon, Clarke Island, 16.xi.1979 (MEL); *J.S.Whinray 2402*, c. 2.1 km ENE Green Hill, Clarke Island, 21.vi.1981 (MEL); *J.S.Whinray 2404*, c. 1.2 km E Bullock Hill, Clarke Island, 4.vii.1981 (MEL); *J.S.Whinray 13243*, Prickly Bottom Flat, Cape Barren Island, 30.x.2007 (AD, MEL).

***Hibbertia ericifolia* Hook.f.**

Fl. Tasmania 1: 14, plate 3 (1855), “*ericaefolia*”; F.Muell., Pl. Indig. Colony Victoria 1: 17 (1862); – non *Pleurandra ericifolia* DC. (1817). — **Type:** Tasmania, near Launceston, *Gunn 1022/1842*, 24.xii.1842 (holo.: K; iso.: BM).

Shrublet up to 0.5 m tall, usually much-branched, decumbent to spreading; branches wiry- to rigid-woody, with pronounced decurrent leaf bases, puberulous, pubescent to pilose. *Vestiture* often not persistent, with simple or rarely forked hairs, usually with longer over shorter ones, but generally sparse to glabrescent; *on branches* sparse to moderately dense, mainly with short spreading to antrorse-appressed simple hairs, or rarely

forked ones, usually overtopped by few to many longer spreading to appressed simple hairs; *on leaves above* scattered, with stout hairs on pustules, but often retaining only \pm prominent pustules or \pm smooth, but usually with some pustules or hairs on the flanks of the revolute margins; *on leaves below* with scattered stout hairs or their pustules, but rarely on the central vein, but often rows of teeth between them and the revolute margins; *on primary bracts* sparse with fine antrorse appressed simple hairs mainly distally; *on outer calyx lobes* outside, scattered or glabrous, with fine short simple hairs at the base and/or margins and with a denser cluster or usually a terminal tuft at the apex, rarely overtopped by few to many longer, spreading often coarser hairs along the central ridge, inside sparse, with fine antrorse-appressed simple, rarely forked hairs on the distal third or sometimes restricted to below the apex; *on inner calyx lobes* outside, usually moderately dense short antrorse-appressed simple or forked and/or fascicled hairs, rarely overtopped by usually few longer spreading simple hairs mainly along the central ridge, inside with a cluster of fine simple hairs below the apex. *Leaves* with intrapetiolar tufts of hairs up to 0.7 mm long but often much shorter and usually slightly decurrent along the margins of the leaf bases; *petiole* 0.2–0.5 mm long; *lamina* linear to narrowly elliptic, (1.3–) 3–6.5 (–14.2) \times (0.4–) 0.5–0.7 (–1) mm, \pm abruptly constricted into short petiole, acute or obtuse becoming rounded and with protruding tufted end of central vein at the apex being straight or becoming recurved, above convex to almost flat and puberulous to pilose, often becoming glabrous but then usually with, rarely without, prominent pustules particularly on the revolute margins, below with a broad usually \pm recessed central vein separated from and exposing the undersurface or often rolled and \pm wedged in, but often with rows of teeth between it and the revolute margins, puberulous usually becoming glabrous and often with long tuft of hairs on end of the central vein. *Flowers* single, terminal and \pm sessile on main branches; *flower stalk* 2–5 mm long, with primary bract close to calyx; *buds* narrowly ovoid to obloid-ellipsoid; *primary bracts* linear to linear-triangular, (1.3–) 1.5–2 (–7.8) \times 0.1–0.4 (–2.3) mm, acute, incurved to hooded, puberulous, particularly distally; additional bracts 0–3, \pm dorsiventrally compressed but usually with distinct revolute margins, usually merging into cauline leaves or all bract-like on axillary short shoots. *Calyx lobes* unequal; *outer calyx lobes* narrowly elliptic, lanceolate or rarely ovate, (3.6–) 4.5–5.5 (–9.2) \times 0.9–1.2 (–2.8) mm, often slightly longer or shorter than inner ones, acute to pointed or rarely obtuse, ridged at least distally, outside puberulous to proximally glabrescent and pubescent at the apex or rarely sparsely strigose with longer antrorse hairs overtopping, inside finely puberulous on the distal third; *inner calyx lobes* ovate-elliptic, rarely broadly elliptic, (3.4–) 4.2–5.5 (–8.7) \times (1.2–) 1.5–2 (–4.2) mm, acute, cuspidate or mucronate, \pm ridged, outside appressed-puberulous to sericeous or

glabrous but commonly pubescent at the apex, inside glabrous with a puberulous patch below the apex. *Petals* obovate, up to 15.8 mm long, \pm bilobed. *Stamens* 10–15 (–30), without staminodes, arranged around the ovaries; *filaments* filiform but slightly broadening towards the base, 1–1.5 mm long; *anthers* broadly obloid, 1–1.6 (–2.2) mm long, abruptly constricted above and below or gradually tapering into petiole. *Pistils* 3; *ovaries* obovoid, each with 4 ovules, hirsute; *style* attached to the upper outer margin, then spreading centrifugally with stigmas borne outside but \pm at the upper level of the anthers. *Fruit* erect, with accrescent calyx, hirsute. *Seeds* obovoid to narrowly ellipsoidal, $1.4\text{--}1.6 \times 1.1\text{--}1.3$ mm, dark brown; *aril* with fleshy attachment surmounted by uneven membranous cup obliquely covering the lower third of the side of the seed.

Diagnostic features. *Hibbertia ericifolia* is so morphologically diverse that it can only be recognised by the combination of sessile flowers without staminodes and usually 8–16 stamens. The species has previously been confused with *H. serpyllifolia*, probably based on the scarcely recurved leaf margins that the two species at times exhibit. However, *H. ericifolia*, especially subsp. *acutifolia*, is distinguished by its acute leaf apex (rounded in *H. serpyllifolia*), a central vein about twice as broad as the revolute margins (narrower) and primary bracts being lanceolate to spatulate (linear to linear-triangular). *Hibbertia ericifolia* occurs mainly inland, south of the Sydney region, whereas *H. serpyllifolia* is restricted to a small area on the central coast of Queensland.

Subsp. *acutifolia* is distinguished by the size and shape of the leaf-like primary bracts. They are flattened so that the undersurface is visible between the central vein and the revolute margins (cf. hypophylls in *H. vestita*). The small primary bracts of subsp. *ericoides* are incurved and the central vein and revolute margins are not strongly developed. These bracts are easily overlooked or misinterpreted, as they are caducous, and then additional bracts and/or subtending reduced leaves could be misinterpreted as the primary bract.

Notes. Mueller (1862) included a number of Victorian specimens of this species under *H. ericifolia*. It would seem that Benth (1863) followed him, but with an even wider concept of the species, as he also included material from New South Wales, as well as Queensland under the earlier name *H. serpyllifolia*. *Hibbertia serpyllifolia* is now regarded as a distinct species in the *H. vestita* subgroup (cf. Note under *H. serpyllifolia*), while the synonymy of the misapplied name refers to both subspecies of *H. ericifolia*.

Hibbertia ericifolia* subsp. *ericifolia

Hibbertia serpyllifolia R.Br. ex DC. var. *minutifolia* F.Muell. ex Benth., Fl. Austral. 1: 32 (1863). — *H. minutifolia* F.Muell., First Gen. Report 9 (1853), nom. inval., nom. nud. — **Type:** Victoria, Mt Aberdeen (= Mt Buffalo), 28.ii.1853 (lecto. — **selected here:** MEL35816A; syn.:

F.Mueller MEL35816B, Buffalo Ranges, 26.ii.1853; possible types: K, MEL 35585 and MEL 1518879).

Hibbertia serpyllifolia R.Br. ex DC. var. *serpyllifolia* auctt. non Benth.: Benth., Fl. Austral. 1: 32 (1863), p.p. excl. type; F.Muell., Native Pl. Victoria: 17 (1879), “*serpyllifolia*”, p.p.; F.Muell., Syst. Cens. 1: 2 (1882), p.p.; C.Moore, Cens. Pl. New South Wales: 1 (1884), p.p.; F.Muell., Key Syst. Victorian Pl. 1: 122 (1887), “*serpyllifolia*”, p.p.; Gilg, Nat. Pflanzenfam. III(6): 117 (1893), p.p.; C.Moore & Betche, Handb. Fl. New South Wales: 10 (1893), p.p.; A.A.Hamilton, Proc. Linn. Soc. New South Wales 24: 354 (1899), p.p.; Rodway, Tasman. Fl. 4 (1903); W.M.Curtis, Stud. Fl. Tasmania 1: 22 (1956), p.p.; N.C.W.Beadle et al. Vasc. Pl. Sydney ed. 2: 230 (1972), p.p.; J.H.Willis, Handb. Pl. Victoria 2: 386 (1973), p.p.; N.C.W.Beadle, Stud. Fl. N.E. New South Wales 3: 255 (1976), p.p.; G.J.Harden & J.Everett in G.H.Harden, Fl. New South Wales 1: 300 (1990), p.p.; Toelken in N.G.Walsh & Entwisle, Fl. Victoria 3: 304(1996), p.p.; Pellow, Henwood & Carolin, Flora Sydney Region ed. 5: 126 (2009), p.p.; M.Gray, Tas. Fl. Online.

Leaf with abaxial central vein up to twice as broad as revolute margins; apex blunt with end of vein \pm reflexed. *Primary bract* linear-lanceolate to linear-elliptic, $(1.3\text{--})1.5\text{--}2.5$ (–3.6) \times 0.1–0.4 mm, one-quarter to one-third of the length of outer calyx lobes, abaxially rarely with central vein visible and margins \pm incurved. *Inner calyx lobes* glabrescent to pubescent with simple, rarely forked hairs. *Flowering:* Mainly September–February, but often extended.

Distribution and ecology. Grows on sandy or gravelly soils on floodplains of rivers, rocky slopes or on shallow soil on granite, often in the understorey of eucalypt woodland in coastal to subalpine conditions in New South Wales (CT, CC, ST, SC), adjoining eastern Victoria (EHL, EG) and the tablelands of northern to mid-Tasmania.

Conservation status. Although sometimes infrequent, *H. ericifolia* subsp. *ericifolia* is widespread and has been recorded from many conservation reserves.

Variation. *Hibbertia ericifolia* subsp. *ericifolia* not only grows in a wide range of habitats, but also includes a number of extreme forms, which could not be adequately distinguished morphologically to justify infraspecific taxa. The leaves of the most widespread form have a broad central vein, with or without rows of teeth; the end of the vein becomes recurved, which gives the leaves a blunt appearance, although the recurved vein-end is usually accentuated by a distal tuft of long simple hairs.

The branches usually become rigid-woody and are covered with often antrorse-appressed short and long simple hairs, except in a subalpine form from the Mount Buffalo area, which was described by Mueller as *H. serpyllifolia* var. *minutifolia*, but is not recognised here. Its often slender branches have spreading to porrect hairs, and more characteristically longer hairs overtopping the usually short ones on the calyx. These characteristics are shared with some Tasmanian

specimens (e.g. *H.D.Gordon* HO3265, *F.H.Long* 210), but the hairs on the leaves are usually twice as long and ascending (not appressed) on these specimens. Very short leaves, typical of plants from the Mt Buffalo area, also occur in plants from East Gippsland, but a few of those specimens then have pubescent to glabrescent calyx lobes (e.g. *C.French* MEL35815, *T.B.Muir* 633), unlike the more sericeous calyx of plants from Mount Buffalo.

A single specimen (*C.P.Gibson* et al. s.n., 29.x.2005) from the Windsor-Singleton area has leaves rarely longer than 3 mm and thread-like branches. This collection resembles *H. pedunculata* as the flowers are slightly stalked, but the primary bract is always at the base of the stalk. *Hibbertia pedunculata* occurs mainly north of the distribution of *H. ericifolia*, but is further distinguished by the glabrescent calyx and absence of staminodes.

Two specimens of *H. ericifolia* subsp. *ericifolia* (*J.H.Willis* MEL695703, *S.J.Forbes* 54) have flowers with more than 15 stamens. This morphology is usually associated with subsp. *acutifolia*; these specimens otherwise agree morphologically with subsp. *ericoides*.

The inner calyx lobes of plants from the Australian mainland often have some forked hairs in addition to small simple hairs.

Typification. Five specimens of the type of *H. serpyllifolia* var. *minutifolia*, collected in 1853 by F. Mueller on Mt Aberdeen, a name later replaced by the older name Mt Buffalo, exist, but the sheets MEL 35585 and MEL1518879 were probably not seen by Bentham, as they are not annotated by him. The other three specimens, viz. one in K and two at MEL, were signed by Bentham. The two specimens in Melbourne are each with an original collector's label and although mounted together on one sheet, MEL 35816, they were collected two days apart. While Bentham examined and signed each of the labels, he does not cite either of these different collecting dates. As these three examined specimens are very similar and display the very short leaves Bentham (1863) refers to in his protologue, the flowering specimen on the left of the sheet MEL35816 is here selected as the lectotype (MEL35816A). As the specimen MEL35816B is of a different collecting date, which Bentham did not acknowledge, it is here treated as a syntype. The specimen at K as well as MEL35585 and MEL1518879 can only be treated as possible types, because it cannot be ascertained whether they were collected on the same day as the lectotype, as only the year (1853) is cited on the labels.

Selection of specimens examined (c. 180 seen)

NEW SOUTH WALES: *E.P.Angst* NSW85825, Yambulla, xi. 1915 (NSW); *E.Ashby* AD97815378, Killara, Sydney, 25.ix.1915 (AD); *W.Bäuerlen* NSW85828, Batemans Bay, x.1890 (NSW); *C.Burgess* CBG12755, 9 miles [14.4 km] NE Marulan, 29.vii.1962 (CANB); *C.Burgess* CBG10913, Kings Tableland, 4.xi.1962 (CANB); *J.H.Camfield* NSW85849, Katoomba, 24.xii.1908 (NSW); *D.O.Cross* NSW127213, between Medlow Bath and Blackheath. 2.x.1938 (NSW);

S.Donaldson 209, *G.Corsini* & *R.J.Rudd*, 15 km W Tianjara Falls, 17.xi.1992 (AD); *N.C.Ford* NSW85831, plateau N Narabeen Lake, 18.ix.1057 (NSW); *E.Gaub* CBG4717, Cotter Dam, 12.ii.1959 (CANB); *E.Gaub* CBG4759, Mt Palarang, 16.v.1951 (CANB); *C.P.Gibson* 62, Kings Waterhole, Wollemi National Park, 22.ix.2000 (AD, NSW); *C.P.Gibson*, *G.W.Carr* & *R.T.Miller* s.n., Stony Creek crossing, Windsor-Singleton road, 29.x.2005 (AD, NSW); *P.Gilmour* 1138, Impressa Moor, Nadgee Nature Reserve, 10.ix.1983 (CANB); *A.A.Hamilton* NSW85836, Cooks River, xi.1900 (NSW); *R.Helms* NSW85832, Flat Rock, vii.1900 (NSW); *P.Hind* 5434 et al., Bargo River at the end of Yarran Road, 6.xi.1987 (NSW); *R.D.Hoogland* 12447, Mount Lowden, 12.xii.1973 (CANB, MEL); *L.A.S.Johnson* & *E.Constable* NSW31038, Big Plain, E Mt Werong, 24.x.1951 (CANB, NSW); *J.H.Maiden* NSW85845, Clarence to Wolgan, xi.1906 (NSW); *J.H.Maiden* NSW85860, Wentworth Falls, x.1898 (NSW); *R.T.Miller* 14a-h, Touga Road, 30.x.2010 (NSW); *R.T.Miller* 16a-c, Yarramunmun forest track, Morton National Park, 30.x.2010 (NSW); *R.T. & J.Miller* s.n., Thirlmere Lakes, junction of Dry Lake Management Trail and Slade Road, 5.x.2008 (AD, NSW); *R.T. & J.Miller* 23.x.2010, Welby Forest Track (AD); *F.Mueller* MEL35821, Twofold Bay, ix.1860 (MEL); *M.E.Phillips* CBG43727, between Mongarlowe and Nerriga, 18.iv.1961 (CANB); *D.W.Shoobridge* CBG13065, 31 miles [44.6 km] Nerriga to Tomerong, 28.x.1962 (CANB).

VICTORIA: *R.Bates* 3616, Bogong High Plains, 23.i.1984 (AD); *A.C.Beaglehole* 31911 & *E.W.Fink*, Mueller River area, Cicada Trail, 20.xi.1969 (CANB, MEL); *A.C.Beaglehole* 35204 & *K.C.Rogers*, Bald Knob, c. 3.2 km S Mt Seldom Seen Tower, 6.xii.1970 (CANB, MEL); *A.C.Beaglehole* 37489, Blaze Road to Tabberabbera Road, 19.iii.1971 (MEL); *A.C.Beaglehole* 41401, Reedy track, Nunniong Plateau, 6.ii.1973 (CANB, MEL); *A.C.Beaglehole* 89177 & *L.W.Huebner*, Burrowa National Park, 23.x.1987 (MEL); *S.J.Forbes* 54, 4 km E Tamboon on Clinton Rocks Track, 31.v.1979 (MEL); *S.J.Forbes* 2950, c. 4 km S Cann River Post Office along Gauge Track, 18.ix.1985 (MEL); *C.French* MEL35815, Buffalo Ranges, xii.1904 (MEL); *R.D.Hoogland* 11920, near Lake Catani, Mt Buffalo National Park (CANB, K, MEL); *R.D.Hoogland* 11923, c. 6 miles [9.6 km] N Wulgulmerang, 29.xii.1973 (MEL, NSW); *T.B.Muir* 633, near Lake Catani, 1.i.1959 (MEL); *N.A.Wakefield* 4033, Cann River, 1946 (MEL); *N.G.Walsh* 6333, Burrowa-Pine Mountain National Park, 19.x.2005 (MEL); *J.H.Willis* MEL35813, near chalet, Mt Buffalo National Park, 21.ii.1963 (MEL); *J.H.Willis* MEL695703, Mid-tops of Mt Burrowa, 17.xi.1971 (MEL).

TASMANIA: *W.H.Archer* NSW121128, Tasmania [without precise locality] (NSW); *R.Brown* s.n., Port Dalrymple, 1.1804 (BM); *F.E.Burbury* HO3274, St Patricks River, – (HO); *P.Collier* 522, ridge N of Cutoff Hill, 12.v.1985 (HO); *M.G.Corrick* 2020, near Prosser Forest, between Launceston and Lilydale, 17.xii.1969 (MEL); *W.M.Curtis* HO29266, Lilydale Road, Launceston, 12.xi.1952 (HO); *W.V.Fitzgerald* HO3257, St Patricks River, 15.xi.1892 (HO); *H.D.Gordon* HO3265, Epping Forest, 19.iv.1946 (HO); *H.D.Gordon* HO3266, Apsley River, S Bicheno, 19.xi.1942 (HO); *F.H.Long* 210, Railton, 24.x.1930 (HO); *J.H.Maiden* NSW121125, Range between Swansea & Campbelltown, i.1902 (NSW); *A.Moscal* 12316, Warners Sugarloaf, 100 m E Meander River, 19.ii.1986 (HO); *L.Rodway* 17, St Patricks River, 15.xi.1892 (HO); *J.Somerville* HO3261, Meander River flats south of Deloraine, 4.i.1959 (HO); *J.H.Wilson* HO3263, Lilydale Road, Launceston, 15.i.1943 (HO); *J.H.Wilson* HO3264, Lilydale Road, Launceston, 15.ii.1943 (HO); *J.H.Wilson* HO116928, Lilydale Road, i.1943 (HO).

***Hibbertia ericifolia* subsp. *acutifolia* Toelken, subsp. nov.**

A subspecies typica bracteis magnioribus ((4.4–) 5.5–7 (–7.8) × 1.3–2.3 mm) et lobis calicis plerumque pilis fasciculatis differt.

Type: New South Wales, Sarahs Knob, R. & J. Miller s.n., 21.x.2006 (holo.: AD; iso.: BRI, CANB, NSW, PERTH).

Hibbertia serpyllifolia R.Br. ex DC. var. *serpyllifolia* auctt. non Benth.: Benth., Fl. Austral. 1: 32 (1863), p.p. excl. type; F.Muell., Native Pl. Victoria: 17 (1879), “*serpyllifolia*”, p.p.; F.Muell., Syst. Cens. 1: 2 (1882), p.p.; C.Moore, Cens. Pl. New South Wales: 1 (1884), p.p.; F.Muell., Key Syst. Victorian Pl. 1: 122 (1887), “*serpyllifolia*”, p.p.; Gilg, Nat. Pflanzenfam. III(6): 117 (1893), p.p.; C.Moore & Betche, Handb. Fl. New South Wales: 10 (1893), p.p.; A.A.Hamilton, Proc. Linn. Soc. New South Wales 24: 354 (1899), p.p.; Rodway, Tasmanian Flora: 4 (1903); N.C.W.Beadle et al. Vasc. Pl. Sydney ed. 2: 230 (1972), p.p.; J.H.Willis, Handb. Pl. Victoria 2: 386 (1973), p.p.; N.C.W.Beadle, Stud. Fl. N.E. New South Wales 3: 255 (1976), p.p.; G.J.Harden & J.Everett in G.H.Harden, Fl. New South Wales 1: 300 (1990), p.p.; Toelken in N.G.Walsh & Entwisle, Fl. Victoria 3: 304 (1996), p.p.; Pellow, Henwood & Carolin, Flora Sydney Region ed. 5: 126 (2009), p.p.

Leaf with abaxial central vein usually more than twice as broad as revolute margins; apex pointed to acute, rarely slightly recurving. *Primary bract* lanceolate to spatulate, (3.2–) 5.5–7 (–7.8) × 1.3–2.3 mm, half to three-quarters the length of outer calyx lobes, abaxially with broad undersurface exposed between the central vein and recurved margins. *Inner calyx lobes* glabrescent with forked to fascicled hairs especially towards the apex. *Flowering:* Mainly September–November.

Distribution and ecology. Grows on sandy soil usually associated with sandstone outcrops in heath-like vegetation usually as understory to eucalypt woodland to forest in the coastal foothills of New South Wales (CC, ST).

Variation. The critical character of this subspecies is the size and shape of the primary bract, which like the hypophylls in *H. vestita* are enlarged and, although somewhat flattened, expose a broad part of the undersurface between the raised central vein and revolute margins. In the typical subspecies the margins of the bracts are more or less incurved and the central vein is indistinct, in addition to the size differences between the two subspecies. Acute leaves have also been, though rarely, recorded in the typical subspecies (e.g. *N.C.Ford NSW85831*), but those specimens are easily identified by the small incurved bracts below the flowers as subsp. *ericifolia*. Similarly remarkably obtuse to rounded leaves have been observed on plants with very short leaves, bracts and smaller flowers (*R. & J.Miller s.n.*, 5.x.2009), but they still show a primary bract with an exposed undersurface between the central vein and revolute margins, typical of subsp. *acutifolia*. Fascicled hairs on the inner calyx lobes of subsp.

acutifolia are not always discernable because they are often so small.

This subspecies, although easily distinguished, can be divided into two extremes merging just south of Sydney. While the northern population around Sydney is more similar to the typical subspecies, a distinct form occurs to the south, mainly along the coastal foothills. It is distinguished by flowers with 18–30 stamens and larger anthers up to 2.2 mm long (typically 8–18 stamens with anthers up to 1.5 mm long). The southern form of this subspecies is in all respects much larger (leaves to 14.2 mm, outer calyx to 9.2 mm, inner calyx to 8.7 and petals to 15.8 mm long) and some of the specimens exhibit very rigid-woody branches of shrubs up to 50 cm tall, e.g. *J.W.Camfield NSW85841*. The two forms grade into each other, and some specimens (e.g. *R.T.Miller s.n.*, 10.ix.2010) even have branches of both types (cf. specimens examined).

An unusual similar increase in the number of stamens has also been recorded in two specimens from eastern-most Victoria (*J.H.Willis MEL695703* and *S.J. Forbes 54*), but they have the short narrow primary bracts characteristic of the typical subspecies. Also their narrow recessed central veins indicate that they are not part of subsp. *acutifolia*, of which no specimens have been recorded from the southern parts of the southern coast of New South Wales.

Etymology. The epithet “*acutifolia*”, Latin “pointed-leaved” refers to the usually straight pointed end of the central vein at the end of the leaves.

Selection of specimens examined (45 seen).

Stamens (8–) 10–16 (–18). NEW SOUTH WALES: *J.W. Camfield NSW85837*, Kogarah, xii.1893 (NSW); *J.W. Camfield NSW85841*, Loftus Park, x.1898 (NSW); *J.W. Camfield NSW85842*, Oatley, 10.xi.1903 (NSW); *A.A.Hamilton NSW 85840*, Yowie Bay, xi.1908 (NSW); *B.Hain CBG57605*, Wattamolla Rd, Royal National Park, 28.viii.1970 (CANB); *P.Hind 5434*, *P.Cuneo* & *G. D'Aubert*, Bargo river gorge at the end of Yarran Road, 6.xi.1987 (NSW); *H.K.Mair & E.F.Constable NSW16112*, Waterfall to Bulli Pass, 8.xi.1950 (NSW); *R.T. & J.Miller s.n.*, laterite track from Bundeena to Coast Track, Royal National Park, 11.ix.2007 (AD, NSW); *R.T. & J.Miller s.n.*, Wattle Ridge, Hill Top, 5.x.2008 (NSW); *R.T. & J.Miller s.n.*, Cave Creek Trail, 5.x.2008 (AD, NSW); *R.T. & J.Miller s.n.*, Old Coast Track, Curra Moors, Royal National Park, 5.x.2009 (NSW); *R.T.Miller s.n. & A.Henderson*, Appin to Wilton Road, under powerlines, 5.x.2008 (NSW); *R.T.Miller s.n.*, S Appin Rd (i), 17.xi.2010 (AD, NSW); *J.Pulley CBG43383*, near Windellama, 6.xi.1965 (CANB); *J.Rodway NSW85839*, west side of Yowie Bay, Port Hacking, 16.ii.1945 (NSW).

Stamens (18–) 20–30. NEW SOUTH WALES: *C.Bryant MEL35823*, Mt Keira, Wollongong, 1954 (MEL); *R.T. & J.Miller s.n.*, Brokers Nose, 28.x.2006 (AD, NSW); *R.T.Miller s.n.*, Sublime Point entrance, 30.ix.2009 (AD, NSW).

Stamens of both types. NEW SOUTH WALES: *R.T.Miller s.n.*, Dharawal National Park, 10.x.2006 (AD, NSW); *R.T.Miller s.n.*, Sebastapol Trig, Heathcote National Park, 12.x.2006 (AD, NSW); *R.T. & J.Miller s.n.*, S. Appin Road, 15.x.2006 (AD, NSW); *R.T.Miller s.n.*, S. Appin, upper Georges River, W Baden Powell Drive, 10.xi.2010 (NSW).

***Hibbertia expansa* Toelken, sp. nov.**

A speciebus aliis turmae H. vestitae nervis centralibus rectis protrudentibus apices foliorum et foliis calicibusque pilis patentibus differt.

Type: New South Wales, 42 km E Glen Innes, H.R.Toelken 8533, 22.xi.1992 (holo.: AD; iso.: BRI, K, MO, NSW, PERTH).

Hibbertia pedunculata auctt. non R.Br. ex DC.: Stanley in Stanley & E.M.Ross, Fl. S.E. Queensl. 1: 188 (1983); G.J.Harden & J.Everett in G.J.Harden, Fl. New South Wales 1: 300 (1990), p. p.; Jessup in Bostock & A.E.Holland, Census Queensland Fl. 63-64 (2007), p.p.

Hibbertia vestita auctt. non A.Cunn. ex Benth.: N.C.W. Beadle, Student's Fl. N.E. New South Wales 3: 256 (1976), p.p.; Stanley in Stanley & E.M.Ross, Fl. S.E. Queensland 1: 187 (1982), p.p.; G.J.Harden & J. Everett in G.J.Harden, Fl. New South Wales 1: 300 (1990), p.p.; Jessup in Bostock & A.E.Holland, Census Queensland Fl. 63/64 (2007), p.p.

Shrublets to 0.35 m high, moderately to much-branched, spreading to decumbent; branches wiry becoming rigid-woody, with distinct decurrent leaf bases, sparsely hirsute, rarely pilose. *Vestiture* persistent, usually dense varying to sparse short spreading simple hairs overtopped by scattered spreading longer ones; *on branches* sparse to moderately dense, with short erect hairs (sometimes very short) overtopped by fine longer ones up to 1 mm long simple hairs often at right angles to stem; *on leaves above and below* with few shorter antrorse simple hairs overtopped by longer spreading ones becoming longer on proximal parts especially on the central vein and on petiole, with usually many reduced hairs varying from small fascicled, forked or simple hairs to teeth, particularly on the margin of the undersurface, which is often exposed between the central vein and revolute margins; *on primary bracts* scattered small antrorse simple hairs overtopped by longer hairs, becoming even longer on the abaxial surface especially on the central vein; *on outer calyx lobes* outside with scattered short simple hairs overtopped by few to many, often very much longer antrorse-spreading ones up to 1.4 mm long, inside with few smaller, sometimes forked appressed hairs overtopped by long to very long ones below the apex; *on inner calyx lobes* outside sparse with short antrorse simple hairs spreading to the glabrous membranous margins overtopped by dense, at least along the central strip, much longer \pm appressed ones, inside dense in a patch with very short antrorse-appressed simple hairs below the apex. *Leaves* with intrapetiolar tuft of hairs up to 0.7 mm long; *petiole* 0.1–0.6 mm long; lamina linear-lanceolate, rarely linear, (2.3–) 3.0–5.5 (–6.3) \times (0.8–) 0.9–1.1 (–1.3) mm, abruptly constricted into the petiole, usually pointed to acute or becoming slightly recurved, above convex or rarely flat with slight depression along the central vein and sparsely hirsute to finely pilose and usually without pustules, below with central vein \pm flush with and often about twice as wide as the revolute margins and sometimes showing the puberulous to smooth undersurface in the gap between the two, with central vein projecting beyond

the leaf apex and sparsely hirsute. *Flowers* single, sessile, subsessile or stalked, terminal on mainly major branches; *flower stalk* 0–6 (–8.4) mm long, with primary bract immediately subtending to close to the calyx; *buds* oblong-ovoid; *primary bracts* linear-lanceolate, (3.1–) 3.5–4.0 (–4.3) \times 0.8–0.9 mm, leaf-like but with scarcely revolute margins and raised central vein mainly towards the apex, additional bracts (0) 1 or 2, merging into cauline leaves. *Calyx* lobes unequal; *outer calyx lobes* lanceolate, (4.4–) 4.5–5 (–5.3) \times (2.2–) 2.4–3.0 (–3.2) mm, often shorter than inner ones, acute to bluntly acute, rarely rounded, with scarcely raised central ridge and slightly revolute margins distally, outside hirsute to strigose, inside appressed-pubescent to sericeous on the distal half; *inner calyx lobes* ovate to ovate-oblong, (4.2–) 4.5–5.2 (–5.6) \times (2.8–) 3.4–4 (–4.2) mm, acute, with faint central ridge and broad membranous margins, outside pubescent to strigose at least along a central strip, inside puberulous below the apex. *Petals* obovate to broadly obovate, up to 10.4 mm long, \pm deeply bilobed. *Stamens* (14–) 20–30, without or with few thread-like staminodes, around the ovaries; *filaments* strap-like, 2.2–2.6 mm long, \pm broadened towards the base, \pm scarcely connate basally; *anthers* narrowly obloid, 1.3–2.4 (–2.7) mm long, above abruptly constricted and below \pm tapering into filaments. *Pistils* 3; *ovaries* obovoid, each with 4–6 ovules, pubescent to hirsute; *style* attached at apex and then spreading sideways with stigmas centrifugal to anthers. *Fruit* pilose to sparsely hirsute. *Seeds* obovoid but often attachment more or less curved to one side, 1.5–1.65 \times 1.1–1.3 mm, dark brown; *aril* with fleshy base and with broadly but shallowly lobed sheath covering one-third to two-thirds of seed. *Flowering*: Mainly October and November, but flowers have also been recorded from most months of the year.

Fig. 2A–E.

Distribution and ecology. Grows on coarse sandy soil between granite in understorey scrub in open eucalypt woodland in south-central Queensland (DD) and north-central New South Wales (NT).

Conservation status. Unknown. Collections from NSW are from before 1970 except for the type of the species.

Diagnostic features. A very variable species which has often been identified as *H. vestita* because of its frequently sessile or subsessile flowers and, particularly, as it has similar spreading hairs on the branches and more or less strigose hairs on the calyx. It is, however, distinguished from most of the taxa in the *H. vestita* group by its usually straight erect projection of the central vein above the leaf apex and the thicker, broad central vein, which is usually touching the revolute margins.

The presence of fascicled hairs and stalked flowers that are generally nodding in the fruiting stage are characteristics of the *H. pedunculata* subgroup. *Hibbertia expansa* shows closest affinity to *H. pedunculata*, but the latter is distinguished by its obtuse to rounded outer

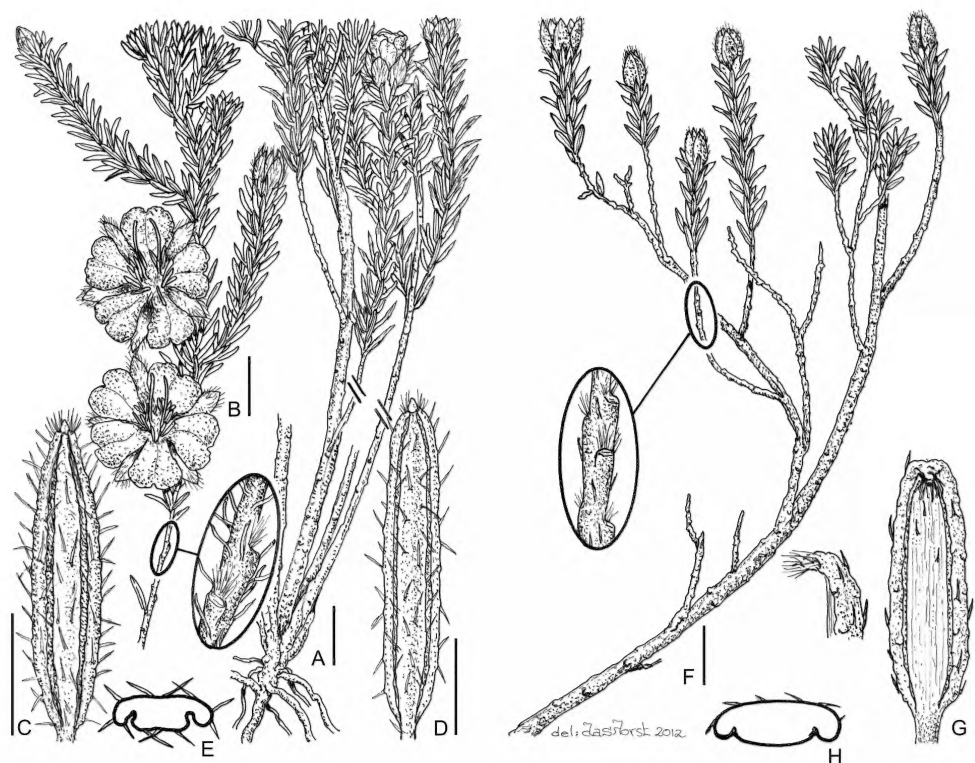


Fig. 2. A–E *H. expansa*: A much branched plant; B flowering branch; C abaxial view of flattened leaf with undersurface visible; D abaxial view of revolute leaf with undersurface scarcely visible; E transverse section through mid-leaf. F–H *H. pachynemidium*: F flowering branch with sessile flowers; G abaxial view of leaf with recurved apex; H transverse section through mid-leaf. — Scale bars: A, B, F 10 mm; C, D, G 2 mm — A, D R.W.Jessup & M.Gray 1940, B, C, E R.H.Cambage NSW85779, F–H J.D.Briggs & M.Parris 2078.

calyx lobes, without pronounced central ridge, and the absence of coarse spreading hairs.

Variation. *Hibbertia expansa* is a very variable species with a number of differing populations, usually associated with apparently disjunct granite outcrops. So far, it is not clear how this variability relates to geographical distribution. For example, some plants have a distinct flower stalk, e.g. *S.L.Everist* & *L.J.Webb* 1293, while the majority of specimens have sessile or subsessile flowers. A full range of intermediate sizes of the flower stalk had already been recorded by the end of the nineteenth century on the specimen *C.Stuart* 565. The recurved flowers in the fruiting stage are here taken as an indication that this species exhibits more characteristics of *H. pedunculata* subgroup rather than the *H. vestita* subgroup. *Hibbertia expansa* thus exhibits a similar range of variation of the flower stalk as in, for instance, *H. porcata*.

Another local variation is spreading simple hairs (0.4–) 0.5–0.7 mm long on leaves, which are often associated with long bristly hairs on the calyx, e.g. *R.Bates* 10842. Furthermore the central vein is usually

not firmly wedged in between the revolute margins, but, particularly on leaves below the flowers, this becomes less tight, so that sometimes the undersurface between margins and vein is visible: in different populations it is either glabrous or covered with fascicled or forked hairs (cf. Fig. 2C).

Although the central vein is more or less clearly projecting beyond the rest of the apex of the leaves, it usually remains straight or may be slightly recurved on older leaves, unlike the reflexed apex in other species of the *H. vestita* group.

Unusually variable are also the number of stamens and the presence or absence of a few staminodes. Remarkable differences in the length of anthers of plants from different localities have also been observed. The very small anthers in *W.McRae* NSW85885 may be attributed to its immature flowers, as could be the very small petals, but the small number of stamens (11) are unusual. However, in the type specimen eleven or twelve stamens are developed, while others remain more or less rudimentary as staminodes. The number of staminodes

in each flower may vary on the same plant and between plants from different localities.

The sheath of the aril varies in covering one- to two-thirds of different seeds of the same fruit (J.L.Boorman NSW86880).

Etymology. The epithet “*expansa*”, Latin “expanded, spread out” refers to the long spreading hairs on all parts of the plant.

Specimens examined

QUEENSLAND: R.Bates 10842, Stanthorpe, 15.x.1987 (AD); S.L.Everist & L.J.Webb 1293, 1 mile [1.6 km] S Dalveen on Stanthorpe Road, 21.xi.1946 (BRI, CANB); D.Halford 1995, 15 km SE Inglewood, 7.x.1993 (BRI); D.Halford 2733, Mount Jabbinder, 34.3 km SW Stanford, 22.ix.1995 (BRI); L.Hazelgrove 189, Mount Jabbinder, xii.2000 (BRI); ?Leichhardt 129, near a waterhole, 6.i.1847 (NSW85862).

NEW SOUTH WALES: J.L.Boorman NSW85781, Torrington, i.1911 (CANB, NSW); J.L.Boorman NSW85784, Torrington, xi.1919 (NSW); R.H.Cambage 1616A, Torrington, 29.ix.1907 (CANB, NSW); R.H.Cambage 1757, Torrington, ix.1907 (NSW85779); E.F.Constable NSW55998, 10 miles [16 km] E Deepwater, on Tent Hill – Torrington road, 13.v.1961 (K, NSW); E.Gauba CBG 4806, Torrington, 12.xii.1951 (CANB, NSW); J.W.Haney 30, Glen Elgin, 24.ii.1930 (CANB); R.W.Jessup & M.Gray CANB126265, 13 miles [20.8 km] S Emmaville, 11.iv.1953 (CANB); C.Kusebysch MEL1009784, Boonoo-Boonoo, xii.1884 (MEL); W.McRae NSW85885, Dandarra Creek, E Glen Innes, 11.x.1967 (NSW); Porter MEL1009670, Glen Innes, iv.1885 (MEL); C.Stuart MEL1009732, New England, – (MEL); C.Stuart 227, Sandy Creek, xi. (MEL1009681); C.Stuart 505, Sandy Creek, xi. (MEL1009667); C.Stuart 565, Sandy Creek, xi. (MEL35573); I.R.Telford 2547, road to Boonoo Boonoo Falls, 29.xi.1970 (CANB).

Hibbertia exponens Toelken, sp. nov.

Hibbertia exposita et *H. pachynemidium* similis sed foliis glabrescentibus nervis centralibus angustis, recessis et plerumque non continguis marginibus revolutis differt.

Type: Victoria: Snowy River, c. 3 miles [4.8 km] SSW Willis, R.D.Hoogland 11925, 30.xii.1970 (holo.: NSW; iso.: CANB, MEL; A, K, L, M, OKLA – n. v.).

Hibbertia pedunculata auctt. non R.Br. ex DC: J.H.Willis, Handb. Pl. Victoria 2: 386 (1973), p.p.; Toelken in N.G.Walsh & Entwisle, Fl. Victoria 3: 304 (1996), p.p.; N.G.Walsh & V.Stajsic, Census Vasc. Pl. Victoria ed. 8: 79 (2007), p.p.

Shrublets up to 0.3 m tall, decumbent to straggling, sparsely branched; branches wiry, with leaf bases scarcely decurrent, sparsely sericeous, rarely pubescent. *Vestiture* not persistent, with scattered longer and shorter antrorse simple hairs usually without obvious pustules on the leaves. *Leaves* with sparse intrapetiolar tuft up to 0.4 mm long and scarcely decurrent; *petiole* 0.2–0.5 mm long; *lamina* linear-oblongate to linear-elliptic, (2.6–) 4.5–6.5 (–8.6) × 0.5–0.8 (–1) mm, gradually tapering into petiole, acute to bluntly acute and recurved with few short hairs on the end of the vein but wearing off

soon, above flat to slightly depressed along the central vein, puberulous to glabrescent, below with recessed narrow central vein separate from the equally broad revolute margins, puberulous or glabrescent. *Flowers* single, terminal on main and axillary branches; *flower stalk* (4.5–) 5–7.5 (–11.3) mm long, with primary bracts towards the base; *buds* ovoid to broadly ellipsoidal; *primary bracts* linear-lanceolate, 2.4–4 × 0.3–0.5 mm, with recurved acute apex, with revolute margins, glabrescent; additional bracts 1–3, grading into cauline leaves. *Calyx* lobes unequal; *outer calyx lobes* ovate, 4.8–5.5 (–5.8) × 2.7–3.1 mm, acute, distinctly ridged, outside appressed-puberulous to glabrescent, inside appressed-puberulous on distal third; *inner calyx lobes* ovate-oblong to oblong-elliptic, (4.6–) 4.8–5.3 × 3–3.4 mm, cuspidate to rounded, rarely truncate or emarginate, scarcely or not ridged, with broad membranous margins, outside appressed puberulous to glabrescent, inside glabrescent below the apex. *Petals* obovate-cuneate, up to 8 mm long, bilobed. *Stamens* 18–26, with or without a few staminodes, arranged around the ovaries; *filaments* narrowly strap-like, 1.2–1.5 mm long, scarcely connate basally; *anthers* obloid, 0.5–1.4 mm long, variable, abruptly constricted above, tapering below. *Pistils* 3; *ovaries* obovoid, with 2 or 4 ovules, tomentose; *styles* attached to the upper outer edge, then curved out and up with the stigmas exposed above the anthers. *Fruit* recurved, pubescent. *Seeds* obloid, with attachment on side, 2–2.1 × 1.5–1.7 mm, dark brown; *aril* with slightly fleshy attachment surmounted by a membranous slightly lobed cup clasping the lower third of the side of the seed. *Flowering:* November–December (April).

Distribution and ecology. Growing on sandy or rocky riverbanks in riparian scrubland including *Acacia boormannii*, *A. floribunda*, *Bursaria spinosa*, *Kunzea ericoides*, *Phebalium glandulosum* and *Calytrix tetragona* (N.G.Walsh 2195 & K.C.Norris) along the Snowy River in Victoria (EG).

Conservation status. Frequency of occurrence of the species is unknown, but it is conserved in the Snowy River National Park.

Diagnostic features. Although *H. exponens* is obviously closely related to *H. exposita* and *H. pachynemidium*, it is a distinct species, not only because of the characteristic narrow central vein and thus an exposed glabrous undersurface of the leaves, but also because it grows on riverbanks unlike the latter two species, which were recorded from slopes or ridges or mountain tops.

The three species are distinguished from most of the other species of the *H. pedunculata* subgroup by their small flowers with short calyces and more or less broadened filaments in comparison to other species. Although *H. basaltica* and *H. dispar* have similar small flowers, they are readily distinguished by their few stamens, which are irregularly distributed around the ovaries.

Variation. A few staminodes were observed in some flowers on some specimens (e.g. *N.G.Walsh 2195* & *K.C.Norris*). The length of the flower stalk (two internodes long) is sometimes not easy to determine because the primary bract is leaf-like with revolute margins and grades into leaves below.

Etymology. The leaves of this species are persistently “exposing, displaying”, Latin “exponens” (present participle), the undersurface between the narrow central vein and revolute margins, as referred to in the epithet. The epithet is therefore derived from the same verb “exponere” as the epithet of the closely related species, *H. exposita* (past participle), although in the two cases applied for different reasons.

Specimens examined

VICTORIA: *A.C.Beauglehole 33205 et al.*, Snowy River Road, 4.1 miles [6.6 km] S New South Wales border, 6.i.1967 (MEL); *J.M.Bechervaise MEL35577*, Gorge tract of the Snowy River, near Deddick, 21.i.1948 (MEL); *E.J.Carroll CBG15689*, c. 5 miles [8 km] E Butchers Ridge, 10.iii.1966 (CANB); *A.W.Howitt 81*, Snowy River bank, 1884 (MEL); *N.G.Walsh 2195* & *K.C.Norris*, Tulach Ard Gorge, 1.9 km NNW helipad on Museum Spur, 15.xi.1988 (MEL); *J.H.Willis MEL119735*, Snowy River Gorge, E Butchers Ridge, 21.iv.1971 (MEL).

Hibbertia exposita Toelken, sp. nov.

Hibbertiae pachynemidio similis sed tuberculis prominentibus in foliis, filamentis filiformibus et lobis calicis plus minusve pubescentibus; a H. intermedia et H. ericifolia calicibus brevioribus et antheris brevioribus differt.

Type: Victoria, Mt Wellington, *R.H.Barley s.n.*, 20.xi.1980 (holo.: MEL627849; iso.: CANB343299).

Hibbertia pedunculata auctt. non R.Br. ex DC: Benth., Fl. Austral. 1: 32 (1863), p.p. quoad *F.Mueller MEL35580* (Austral. Alps); *J.H.Willis*, Handb. Pl. Victoria 2: 386 (1973), p.p.; Toelken in *N.G.Walsh & Entwisle*, Fl. Victoria 3: 304 (1996), p.p.; *N.G.Walsh & V.Stajsic*, Census Vasc. Pl. Victoria ed. 8: 79 (2007), p.p.

Shrubs up to 0.15 mm tall, much-branched, mat-forming; branches wiry but soon becoming rigid, with scarcely decurrent leaf bases, pubescent to puberulous or glabrescent. *Vestiture* rarely persistent, with simple or forked hairs; *on branches* sparse to moderately dense with short simple and/or forked hairs particularly on the flower stalk; *on leaves above* scattered, with longer and shorter antrorse simple hairs on \pm pronounced pustules, becoming larger on the flanks of the revolute margins and a distinct tuft present on the terminal mucro of the central vein; *on leaves below* with pustulate antrorse simple hairs on the revolute margins and rarely with rows of teeth between the revolute margins and the central vein; *on primary bracts* with terminal tuft of simple hairs and some marginal cilia; *on outer calyx lobes* outside usually glabrous except for a few proximal and terminal appressed simple hairs, inside with few antrorse appressed simple and forked hairs below the apex; *on inner calyx lobes* outside glabrous except for few antrorse appressed simple hairs proximally

and terminally, or rarely on the distal half, sometimes with distal cilia, inside glabrous except for a cluster of short appressed hairs below the apex. *Leaves* with short intrapetiolar tufts up to 0.3 mm long; *petiole* 0.2–0.4 mm long; *lamina* narrowly oblong to linear, (1.4–) 2.5–3.5 (–4.4) \times 0.6–0.8 (–1) mm, gradually tapering into petiole, obtuse to rounded but with recurved projection of vein with short terminal tuft, above convex to flat with a slight depression along the central vein, with scattered pustules with or without antrorse simple hairs, particularly well-developed on the flanks of the revolute margins, below with broad central vein flush to slightly recessed from and tightly wedged in between the revolute margins, sparsely tuberculate on revolute margins. *Flowers* single, terminal on main branches; *flower stalk* (5.6–) 8–15 (–18.5) mm long, with primary bract towards the base; *buds* ellipsoidal; *primary bracts* linear-triangular, 1.1–1.3 (–1.4) \times c. 0.2 mm, acute, dorsiventrally compressed but \pm incurved, ciliate on the distal half, grading into 1–4 fleshy additional bracts and the subtending cauline leaves. *Calyx* lobes unequal; *outer calyx lobes* lanceolate to lanceolate-elliptic, (3.1–) 3.3–4 (–4.5) \times 1.4–1.7 (–2) mm, acute, with distinct central ridge, outside glabrescent to glabrous except terminally pubescent or sometimes with cilia towards the apex, inside puberulous on distal third; *inner calyx lobes* oblong-elliptic, (3.6–) 3.8–4.4 (–4.8) \times (2.2–) 2.8–3.2 (–3.4) mm, \pm ridged, outside glabrous or glabrescent, inside puberulous below the apex. *Petals* broadly obovate, up to 7.5 mm long, emarginate to slightly bilobed. *Stamens* 10–14, without staminodes, arranged around the ovaries; *filaments* filiform, 1.1–1.7 mm long, scarcely connate basally; *anthers* obloid, 0.6–0.8 mm long, abruptly constricted above and below tapering into filament. *Pistils* 3; *ovaries* obovate, each with 2 ovules, tomentose; *style* attached to the outside margin of the ovaries, then spreading out and up with the stigmas well above the anthers. *Fruit* and *seeds* not seen. *Flowering:* November–January.

Distribution and ecology. Grows on shallow soil on rocks or between rocks in sub-alpine woodland with *Eucalyptus pauciflora*, *Goodenia hederacea*, *Bossiaea alpina* (recorded as *B. foliosa*) and *Poa fawcettiae* (*D.E.Albrecht 2997* & *N.G.Walsh*) in Victoria (EHL).

Conservation status. The species is conserved in the Alpine National Park where it was described as “locally common” by *D.E.Albrecht 2997* & *N.G.Walsh*.

Diagnostic features. *Hibbertia exposita* differs from *H. intermedia* and *H. ericoides* by its smaller flowers and especially by its shorter anthers (0.6–0.8 mm long). It is very similar to *H. pachynemidium*, but easily distinguished by the prominent pustules of the hairs on the upper leaf surface and in particular on the revolute margins, by its more or less hairy outer calyx lobes and by filiform filaments, which are scarcely connate basally.

Variation. The specimens *F.Mueller* MEL35571 & MEL35572 are unusual as they have flowers slightly more hairy and the central vein of the leaves is only just broader than the revolute margins, but unfortunately no detailed locality or date of collection is available to possibly relocate and explore similar populations. The length of the leaves and calyx varies considerably.

Etymology. The epithet “*exposita*”, Latin “exposed”, refers to its habitat as the species has been recorded from the top of exposed rock outcrops.

Specimens examined

VICTORIA: *D.E.Albrecht* 2997 & *N.G.Walsh*, Mt Wellington summit ridge, 3.i.1987 (MEL); *R.H.Barley* MEL629688, Mt Wellington, – (MEL); *A.C.Beaglehole* 43473, c. 0.4 km SE Moroka Hut, 2.xi.1973 (CANB, MEL); *A.C.Beaglehole* 41144 & *E.H.Chesterfield*, near summit of Mt Wellington, 8.i.1973 (CANB, MEL); *F.Mueller* MEL35571, Australian Alps, – (MEL); *F.Mueller* MEL35572, lower parts of the Australian Alps, – (MEL); *F.Mueller* MEL35580, Mt Wellington, xi.1854 (MEL); *T.B.Muir* 1009, summit of Mt Wellington, 2.i.1960 (MEL).

Hibbertia florida Toelken, sp. nov.

A. H. fruticosa foliis oblongo-lanceolatis nervisque centralibus vix prudentibus super apicem et calycibus pilis patentibus differt.

Type: New South Wales, Mount Dowe, *H.R.Toelken* 8546, 24.xi.1993 (holo.: AD; iso.: B, BRI, CANB, G, K, MEL, MO, NSW, PERTH).

Hibbertia pedunculata auct. non R.Br. ex DC.: N.C.W. Beadle, Stud. Fl. New South Wales 3: 250 (1976), p.p.; G.J.Harden & J.Everett in G.J.Harden, Fl. New South Wales 1: 300 (1990), p.p.

Shrublets up to 0.8 m high, decumbent to spreading, much branched; branches weak-woody to rigid-woody and spreading, with leaf bases shortly decurrent, sericeous, rarely sparsely hirsute. *Vestiture* ± persistent, with very long antrorse, often almost appressed simple hairs usually with obvious tubercles and/or pustules, overtopping a range of medium to very short spreading simple or forked hairs; *on branches* ± dense on leaf bases, with spreading to ± appressed long fine simple hairs similar to those of the intrapetiolar tufts but with basal tubercles; *on leaves above* scattered to glabrescent, often subequal simple hairs with prominent basal pustules, becoming denser and often longer towards the petiole; *on leaves below* sparse to glabrescent, with antrorse spreading simple hairs on revolute margins and central vein, sometimes exposing the glabrous undersurface between them or with rows of teeth along their touching margins, with a tuft of hairs on recurved end on the central vein; *on primary bracts* similar to leaves but sparser, finer and without pustules; *on outer calyx lobes* outside sparse to moderately dense with longer spreading antrorse simple hairs with distinct tubercles merging into fewer finer short simple hairs, inside with scattered short simple hairs along the distal margins; *on inner calyx lobes* outside, moderately dense antrorse appressed simple hairs becoming shorter and

sometimes forked towards the margins; inside glabrous. *Leaves* with sparse to dense intrapetiolar tufts of hairs 0.4–0.6 mm long and usually decurrent along both sides of the leaf base; *petiole* up to 0.7 mm long; *lamina* oblong to oblong-lanceolate, (2.1–) 2.5–5.0 (–5.4) × (0.85–) 1–1.4 (–1.6) mm, ± abruptly constricted into petiole, acute to mucronate, becoming obtuse and with tufted central vein shortly protruding and recurved, above ± flat, puberulous to glabrous, but persistently tuberculate, below with broad flush to recessed central vein ± tightly wedged in between the revolute margins, sometimes exposing the glabrous undersurface, point of contact with central vein with ± teeth along contacts, puberulous to glabrous, but with prominent pustules retained at least along the revolute margins and tufted to glabrous recurved apex of the central vein. *Flowers* single, terminal mainly on smaller lateral branches; *flower stalk* (2.1–) 3–5.5 (–8.4) mm long, with primary bracts subtending calyx or on distal half, rarely below the middle; *primary bracts* linear, linear-elliptic, 2.1–3.5 × 0.3–0.5 mm, flat, with scarcely recurved margins, acute to acuminate and recurved apex, puberulous to glabrescent; additional bracts 0–3, leaf-like and fleshy, merging into cauline leaves. *Calyx* lobes unequal; *outer calyx lobes* elliptic to elliptic-lanceolate, (5.1–) 5.3–5.8 (–6.1) × (2.2–) 2.3–2.8 (–3.3) mm, acute to pointed, with central ridge developed on distal third, outside pubescent to sparsely hirsute, inside puberulous to glabrescent on distal margins; *inner calyx lobes* broadly elliptic to elliptic-ovate, (5.2–) 5.4–6 (–6.6) × 3.7–4.4 mm, rounded, emarginate or mucronate, outside pubescent, inside glabrous. *Petals* broadly obovate, up to 9.6 mm long, bilobed. *Stamens* 12–28, without staminodes arranged around the ovaries; filaments filiform, 0.8–1.3 mm long, scarcely connate basally; *anthers* obloid, 1.1–1.7 mm, usually verruculose-papillate, abruptly constricted above and below tapering into petiole. *Pistils* 3; *ovaries* obovoid, each with 4 ovules, tomentose; *styles* attached to the outer apex then curved back and erect or with stigma ± incurved. *Fruit* recurved, hirsute to woolly with mainly simple hairs. *Seeds* not seen.

Diagnostic features. *Hibbertia florida*, and in particular subsp. *angustinervis*, is similar to *H. fruticosa*, because of its often shrubby habit, but it shares with typical *H. florida* the broader oblong-lanceolate leaves with mucronate apex.

Variation. The leaves of specimens from the Warrumbungle Range tend to be broader than those of the typical subspecies, but the central vein is usually scarcely swollen and distinctly recessed, so that the glabrous undersurface is usually visible between it and the revolute margins. The central vein of the typical subspecies is not only broader and thicker so that it is more or less flush with the revolute margins, but it also has rows of teeth; these are also present on the revolute margins of the leaves at the contact zone. The two forms of this species are distinct and geographically isolated,

in contrast to forms of *H. expansa*. They are therefore treated as subspecies.

Although the position of the bracts seems to be subtending the flower (or rarely on the distal half of the flower stalk) in subsp. *florida* and on the lower half on plants of subsp. *angustinervis*, this character might not be as distinctive, once a larger number of specimens is available for examination.

The number of stamens in each flower varies greatly and, although the typical subspecies has often fewer than 20 and subsp. *angustinervis* more than 24, a few intermediates have been recorded. Similarly the length of anthers shows much variation, but again this could not be used taxonomically.

Etymology. One will best appreciate the epithet “*florida*”, from the Latin “*floriferous*” when one has seen the carpets of yellow flowers of the typical subspecies covering rock shelves.

Hibbertia florida subsp. *florida*.

Shrubs up to 0.35 m high, with decumbent wiry-woody branches. *Central vein* of leaves flush or slightly recessed from and broader than revolute margins at mid-leaf, not exposing undersurface between them and with rows of marginal teeth. *Primary bract* usually subtending calyx or on the distal half of flower stalk. *Flowering*: October and November.

Distribution and ecology. Grows on shallow loamy soil on rocks in and around woodland on the Nandewar Range, New South Wales (NWS).

Conservation status. Locally common within Kaputar National Park (Toelken 8546).

Variation. Young growth often looks very distinct because the wiry branches usually have long internodes and few lateral branches; more intense branching will start in the second year. Slow growth will develop firmer branches, but they rarely become rigid-woody in this subspecies.

Specimens examined

NEW SOUTH WALES: *R.H.Cabbage* NSW85823, Mt Lindsay, xi.1909 (NSW); *R.Coveny* 8950 & *S.K.Roy*, Eckfords Lookout track, 22.xi.1976 (CANB); *J.M.Fox* 87/125, Mt Dowe, 25.xi.1987 (CANB).

Hibbertia florida subsp. *angustinervis* Toelken, subsp. nov.

A subspecies typica habitu patente ramis lignosis et venis centralibus angustioribus foliorum differt.

Type: New South Wales, 34 km SW Coonabarabran, *H.Streimann* 767, 13.xii.1973 (holo.: AD; iso.: BRI 180742; A, CANB, L, K – n.v.)

Shrubs up to 0.8 m high, with spreading branches becoming rigid-woody. *Central vein* of leaves scarcely thickened and very much recessed from and up to as broad as revolute margins at mid-leaf, exposing the glabrous undersurface between them and without rows of marginal

teeth. *Primary bract* usually situated on the lower half of the flower stalk. *Flowering*: October–December.

Distribution and ecology. Grows in wet depressions on rock shelves in and near the Warrumbungle Range in central New South Wales (NWS).

Conservation status. Rare in the Warrumbungle National Park.

Variation. Although young branches are wiry-woody, they soon become rigid-woody.

Etymology. The epithet “*angustinervis*”, Latin “*narrow-veined*”, refers to the narrow central vein of the leaves which is accentuated by the broader leaves of this subspecies.

Specimens examined

NEW SOUTH WALES: *G.W.Althofer* s.n., Fluted Mountain, Warrumbungle Ranges, 6.x.1946 (MEL, NSW); *A.G.Floyd* 651, Warrumbungle National Park, 14.x.1977 (CANB).

Hibbertia fruticosa Toelken, sp. nov.

A speciebus aliis turmae H. vestitae, praecipue H. florida, bracteis subtentis calicem, ramis rigido-lignosis et foliis angustioribus nervis centralibus prudentibus super apicem calicibusque glabrescentibus differt.

Type: New South Wales, Mount Kaputar Road, *R.D.Hoogland* 12304, 4.xi.1972 (holo.: BRI; iso.: CANB, NSW; HBG, K, L, UC, US – n. v.).

Hibbertia pedunculata auctt. non R.Br. ex DC.: N.C.W. Beadle, Stud. Fl. New South Wales 3: 250 (1976), p.p.; G.J.Harden & J.Everett in G.J.Harden, Fl. New South Wales 1: 300 (1990), p.p.

Shrubs up to 1.2 m tall, with few to several erect stems, much branched; branches rigid-woody, with leaf bases shortly decurrent, sericeous to glabrescent. *Vestiture* usually not persistent, with ± appressed fine long simple hairs with a basal tubercle over short to very short erect ones; *on branches* ± dense or sparse on leaf bases, with ± appressed long fine simple hairs with fine basal tubercles overtopping very short erect simple hairs; *on leaves above and below* scattered, with very short antrorse simple hairs soon becoming glabrous except for distinct pustules and similar short-lived short simple hairs on the terminal end of the protruding vein; *on primary bracts* glabrous or almost so and with a few short marginal cilia; *on outer calyx lobes* outside, puberulous with very short simple hairs without pustules proximally and distally as well as on the margins but soon wearing off, inside with longer and shorter appressed simple hairs on the distal third; *on inner calyx lobes* outside, puberulous with very short simple, rarely forked hairs without tubercles mainly along the central ridge and apex; inside with a tuft of short simple hairs below the apex. *Leaves* with sparse intrapetiolar tufts of hairs up to 0.5 mm long and usually decurrent along both sides of the leaf bases; *petiole* up to 0.6 mm long; *lamina* linear to linear-lanceolate, rarely oblong, (2.8–) 3.8–5.5 (–7.9) × 0.5–0.7 (–0.85) mm,

often abruptly constricted into petiole, acute or pointed, with central vein overtopping apex, rarely recurved, above slightly convex to flat and usually glabrous but distally tubercled, below with recessed central vein usually narrower than but tightly wedged in between the revolute margins and both usually with rows of teeth at contact zone, usually glabrous but distantly tubercled. *Flowers* single, terminal mainly on short lateral shoots; *flower stalk* (1.5–) 2.5–4 (–6.7) mm long and often elongating when fruiting, with primary bract usually subtending or on distal third of the stalk; buds ovoid to broadly ovoid; *primary bract* 1, linear-elliptic, rarely linear-triangular, (1.3–) 1.4–1.7 (–1.9) \times 0.2–0.3 (–0.45) mm, with scarcely recurved margins, acute to pointed, with apex \pm recurved, merging into cauline leaves. *Calyx lobes* unequal; *outer calyx lobes* elliptic-oblong or lanceolate- to ovate-elliptic, (4.9–) 5.2–5.8 (–6.4) \times (2.2–) 2.4–2.7 (–4.4) mm, acute and recurved, with central ridge developed in distal third, outside puberulous to glabrous, inside puberulous distally; *inner calyx lobes* broadly elliptic to elliptic-obovate, (5.8–) 6.0–6.6 (–7.05) \times (3.4–) 3.6–4.2 (–4.4) mm, rounded rarely cuspidate, without ridge, outside puberulous to glabrescent; inside puberulous below apex. *Petals* broadly obovate, up to 9.1 mm long, bilobed. *Stamens* (15–) 18–35, with or without staminodes, arranged around the ovary; filaments filiform, 1.1–1.3 mm long, scarcely connate basally; *anthers* oblong, 1.1–1.6 mm, usually verruculose-papillate, \pm abruptly constricted above and below. *Pistils* 3; *ovaries* obovoid, each with 4–6 ovules, tomentose to shortly hirsute; *style* arising laterally from below the apex of ovary and more or less erect or with stigma usually incurved. *Fruit* recurved, hirsute to tomentose with mainly simple hairs. *Seeds* obovoid, 1.7–1.9 \times 1.5–1.8 mm, dark brown; *aril* off-white, with a fleshy attachment and surmounted by membranous scarcely lobed sheath clasping the lower third to half of the seed.

Diagnostic features. *Hibbertia fruticosa* is very similar to *H. florida*, but easily distinguished by its narrower and glabrescent leaves and calyx; unlike the latter it grows on dry rocky slopes. Although it has bracts subtending the calyx, as also found in *H. pedunculata*, it is distinguished by its robust woody habit, acute outer calyx lobes and flowers that are mainly borne on shorter lateral shoots.

Variation. Unusual in this species are young, slender almost unbranched stems next to senescent, short and much branched ones, sometimes on the same plant. Although this is not unusual in other species of *Hibbertia*, it is rarely observed in this group.

One to four staminodes are found laterally (in respect to the bract) in flowers of this species. In some of these no anther develops, but on others rudimentary anthers are found, but they do not dehisce.

Etymology. Unlike most other species in the *H. pedunculata* subgroup, *H. fruticosa* has rigid-woody stems which form shrubs up to 1.2 m tall. This explains the choice of the epithet “fruticosa”, Latin “shrubby”.

***Hibbertia fruticosa* subsp. *fruticosa*.**

Shrubs up to 1.2 m tall. *Leaf lamina* (4.3–) 5–8 (–10.7) mm long, pointed with central vein distinctly protruding, the leaf apex and adaxial leaf bases usually glabrous. *Outer calyx lobes* (2.2–) 2.4–2.7 (–3.5) mm broad. *Flowering*: October and November.

Distribution and ecology. Locally common on rocky slopes usually in open woodland, but restricted to the northern part of the Nandewar Range, N.S.W. (NWS).

Conservation status. Locally common, but restricted to Kaputar National Park.

Specimens examined

NEW SOUTH WALES: *R.Coveny* 8877 & *S.K.Roy*, towards Dawson Spring, 21.xi.1976 (CANB, NSW; K, L, RSA – n.v.); *R.Coveny* 9029 & *S.K.Roy*, Waa Gorge, 23.xi.1976 (CANB, NSW); *K.Hill* 2769 *et al.*, Waa Gorge, 20.x.1987 (NSW, BRI); *H.R.Toelken* 8554, Waa Gorge, 25.xi.1993 (AD, BRI, NSW, PERTH).

***Hibbertia fruticosa* subsp. *pilligaensis* Toelken, subsp. nov.**

A subspecie typica foliis brevioribus et obtusis lobisque calicis latioribus differt.

Type: New South Wales, Pilliga scrub, *R.Bates* 10691, 13.x.1987 (holo.: AD; iso.: NSW).

Shrubs up to 0.7 m tall. *Leaf lamina* (2.2–) 2.5–4 (–4.6) mm long, acute becoming obtuse, with central vein \pm ending in leaf apex or slightly recurved and adaxial leaf bases pubescent to puberulous. *Outer calyx lobes* (3.8–) 4–4.4 mm broad. *Flowering*: October–December.

Distribution and ecology. Grows in shallow loamy sand in eucalypt woodland in central New South Wales (NWP).

Conservation status. Unknown frequency, but conserved in Pilliga Nature Reserve.

Variation. *H.Streimann* 709 has several long branches with new growth, but the length of the leaf lamina still falls well into the normal range of this subspecies. The central vein of the young leaves of this specimen also does not protrude beyond the leaf apex, showing that this characteristic of the subspecies is not just found on specimens growing under more arid conditions.

Etymology: The epithet “pilliga-ensis”, Latin “belonging to the Pilliga region”, was chosen as the subspecies is known only from the Pilliga State Forest.

Specimens examined

NEW SOUTH WALES: *D.F.Mackay* NSW413143, Pilliga East State Forest, 25.x.1986 (NSW); *H.Streimann* 709, Pilliga scrub, 35 km SE Gwabegar, 10.xii.1973 (BRI).

***Hibbertia horricomis* Toelken, sp. nov.**

A speciebus turmae H. vestitae pilis radiale fascicularibus patentibus in foliis differt.

Type: New South Wales, Deua National Park, c. 3 km S MtDonovan, P.Gilmour 4797, 14.x.1984 (holo.: CANB).

Shrubs up to 0.3 m tall, much-branched, erect-spreading; branches rigid-woody, with decurrent leaf bases but not flanged, shortly hispid. *Vestiture* persistent, fascicled hairs often on prominent pustules; *on branches* dense to very dense, with small fascicled hairs (2–5 usually unequally long arms) under larger spreading ones (6–10 usually unequally long arms); *on leaves above* dense, with spreading fascicled hairs (2–4 (5) often unequal arms) on prominent pustules, becoming denser and antrorse above the petiole; *on leaves below* sparse to scattered, with antrorse-spreading fascicled hairs ((1) 2 or 3 unequal arms) but smaller on recessed central vein; *on bracts* ± dense above and below, ± similar to but smaller and more antrorse than those fascicled hairs of the leaves; *on outer calyx lobes* outside dense, with a range of small to larger spreading fascicled hairs (2–12 often subequal arms), inside dense, with forked appressed hairs on the distal third; *on inner calyx lobes* dense, with larger antrorse-spreading hairs mainly along the central ridge over smaller fascicled hairs which continue to the membranous margins, inside with a small patch of antrorse forked hairs below the apex. *Leaves* with sparse intrapetiolar tufts of hair up to 0.3 mm long; *petiole* 0.3–0.7 mm long; *lamina* linear to linear-elliptic, (2.4–) 3.5–6.5 (–9.2) × (0.6–) 0.7–1.2 mm, gradually tapering into petiole, obtuse to rounded, above flat to convex, shortly hispid to bristly, below with prominent central vein ± flush with and broader than revolute margins, with undersurface not visible, shortly hispid to bristly. *Flowers* sessile, terminal on major branches; *buds* broadly ovoid; *primary bract* linear-oblongate, 1.8–2.5 × 0.4–0.5 mm, acute and with terminal tuft, with recurved margins, pubescent; additional bracts 3 or 4, merging into cauline leaves. *Calyx lobes* unequal; *outer calyx lobes* ovate, 6.8–7.3 × 1.5–2.2 mm, sometimes slightly longer than inner ones, acute and often with distal margins slightly recurved, slightly ridged towards the apex, outside shortly hirsute to rough pubescent, inside finely pubescent on the distal third; *inner calyx lobes* broadly ovate-elliptic, 6.7–7.3 × 3.2–4.3 mm, obtuse to rounded, usually ridged towards the apex, outside hirsute becoming puberulous to glabrous on the membranous margins, inside with fine tuft below the apex. *Petals* broadly obovate, 7.5–9.5 mm long, emarginate. *Stamens* 20–24, without staminodes, around the ovaries; *filaments* filiform, 1.2–1.4 mm long, scarcely broadened and barely connate at the base; *anthers* narrowly obloid, 0.9–1.2 mm long, abruptly constricted above and below. *Pistils* 2; *ovaries* obovoid, each with 4 ovules, hirsute; *style* attached to apex of ovaries, erect with stigmas well above the stamens. *Fruit* and *seed* not seen. *Flowering:* June–October.

Distribution and ecology. Grows on usually skeletal soil over rhyolite on ridge tops or ± steep slopes, often above cliffs in open eucalypt forest dominated by *E. sieberi*; apparently restricted to Mount Donovan, New South Wales (ST).

Conservation status. Rare, but conserved in Deua National Park.

Diagnostic features. The prominent pustules, together with the spreading large fascicled hairs on the leaves, are distinctive in the *H. vestita* group. *Hibbertia horricomis* therefore superficially resembles species of the *H. strigosa* group, but differs in staminal arrangement.

Etymology. The epithet “horricomis”, Latin “bristly”, refers to the stiffly spreading hairs particularly on the leaves and branches.

Specimens examined

NEW SOUTH WALES: Mt Donovan, Deua National Park: P.Beasley 399 & D.Binns, 28.iii.1984 (CANB); P.Beasley 403 & D.Binns, 28.iii.1984 (CANB); P.Gilmour 4641, 15.v.1984 (CANB).

***Hibbertia intermedia* (DC.) Toelken**

J. Adelaide Bot. Gard. 25: 74, Fig. 1E–H (2012). — *Pleurantha intermedia* DC., Regn. Veg. Syst. Nat. 1: 420 (1817); Prodr. 1: 72 (1824); Spreng., Syst. Veg. ed. 16, 2: 462 (1825); G.Don, Gen. Hist. 1: 64 (1842). — **Type citation:** “in montibus Novae-Hollandiae. Caley” (holo.: G-DC).

Hibbertia pedunculata auct. non R.Br. ex DC.: Benth., Fl. Austral. 1: 32 (1863), p.p.; G.J.Harden & J.Everett in G.J.Harden, Fl. New South Wales 1: 300 (1990), p.p.;

Shrubs to 0.5 m high, with spreading to procumbent branches; branches wiry becoming rigid-woody, with raised leaf bases decurrent and ± flanged, pubescent to glabrescent. *Vestiture* ± persistent, dense to sparse with mixed longer and shorter mainly simple hairs (rarely bifid) often on distinct tubercles; *on branches* moderately dense to denser between the decurrent leaf bases, with mainly long hairs over few shorter antrorse simple ones with basal tubercle; *on leaves above* not persistent, with scattered antrorse, ± appressed short hairs (subequal) on pustules particularly on the flanks of revolute margins; *on leaves below* not persistent, with very few hairs similar to upper surface, very rare on central vein except with persistent terminal tuft; *on primary bracts* like on leaves but often more spreading and without pustules; *on outer calyx lobes* outside glabrous or with scattered short hairs without tubercles mainly on distal central ridge, inside glabrous, rarely with few scattered hairs towards the apex; *on inner calyx lobes* outside glabrous to very finely hairy on distal central area, inside glabrous. *Leaves* with sparse intrapetiolar tufts up to 0.6 mm long and usually decurrent along both sides of the leaf bases; *petiole* 0.2–0.7 mm long; *lamina* linear to narrowly oblong, (1.8–) 2.3–3.0 (–4.6) × (0.45–) 0.6–0.8 (–1.1) mm, gradually constricted into the petiole, acute with recurved end of central vein covered with long terminal tuft of hairs wearing off and becoming obtuse, above

flat, puberulous soon glabrescent, with pustules usually flat or recessed, below with central vein recessed from, wedged, often with rows of teeth in between revolute margins which are glabrescent as above. *Flowers* single, terminal on main and lateral branches, rarely on short shoots, with narrow base; *flower stalk* (2–) 3–5 mm long, with primary bract towards base; *primary bracts* linear or linear-triangular, 1.8–2.8 × 0.1–0.2 mm, with scarcely recurved margins, almost membranous, often shortly ciliate; additional bracts few, grading into cauline leaves. *Calyx lobes* unequal; *outer calyx lobes* narrowly elliptic, elliptic-lanceolate, 4.5–5.1 × 1.9–2.2 mm, acute, with central ridge more or less developed, outside puberulous to glabrescent, inside glabrous or sometimes with few hairs distally; *inner calyx lobes* elliptic-obovate, 4.4–4.8 × 3.1–3.4 mm, rounded to mucronate, outside papillate to glabrous, inside glabrous. *Petals* obovate, up to 6.8 mm long, bilobed. *Stamens* 7–9 (–10) and without staminodes, surrounding ovaries; filaments filiform, 1.6–1.8 mm long, scarcely basally connate; *anthers* obloid to broadly obloid, 1.6–1.9 mm long, abruptly constricted above and below, smooth or almost so. *Pistils* 3 or 4 (5); *ovaries* obovoid, each with 2–4 ovules, hirsute with simple hairs; *style* attached to the somewhat flattened apex then recurved and finally flexed upwards to place the incurved stigmas just above the apex of the anthers. *Fruit* and *seeds* not seen. *Flowering*: October, November–March. (Toelken 2012a, Fig. E–H).

Distribution and ecology. Grows on sandy soil on sandstone formation, usually on wet often steep slopes in low heath, scrub or “low woodland with *Eucalyptus sieberi*, *E. piperita*, *Angophora costata*, in tall dense shrubbery of *Hakea dactyloides*, *H. pachyphylla*, *H. constablei*, *Ceratopetalum gummiiferum* etc” (A.E.Orme 396 & R.Johnstone) in New South Wales (CT, CC). Noted at one small locale only within the riparian zone of the Grose River growing atop of large flat-topped sandstone boulders and rooting at some nodes (R.T. & J.Miller 73).

Conservation status. “Not common” (A.E.Orme 396 & R.Johnstone), but conserved in the Blue Mountains National Park.

Diagnostic features. Following Bentham (1863), *H. intermedia* has been included under *H. pedunculata* by subsequent authors, but it is readily distinguished from the latter by its glabrous or glabrescent calyx lobes, the outer of which are acute and more or less ridged, and the bract borne at the base of the flower stalk.

Although superficially similar to *H. ericoides*, *H. intermedia* differs by its stalked flowers with the primary bracts borne towards the base of the flower stalk, the generally exposed leaf undersurface and 7–10 stamens.

The length of the flower stalk varies, but is never as long as in *H. exposita*, a superficially similar species from the Moroka Range, Victoria (see Toelken & Miller 2012). That species also differs by a broad central vein and anthers 0.6–0.8 mm long.

Notes. MEL 35567, from “Parramatta, N.S.W.” agrees in all respects with *H. intermedia*, but the locality is very much outside of the presently known range of the species. This specimen is likely to have been collected by the Rev. Woolls who lived in Parramatta. The locality possibly refers to his residence rather than where the plant was collected.

Specimens examined

NEW SOUTH WALES: *Miss Atkinson* MEL35569, Blue Mountains (MEL); *E.F.Constable* NSW85844, Blackheath, 17.xi.1946 (NSW); *M.J.Fletcher* NSW223148, near Warragamba Dam, 31.i.1972 (NSW); *A.A.Hamilton* NSW85843, Blackheath, xi.1914 (NSW); *A.A.Hamilton* NSW85856, Leura, 23.xi.1912 (NSW); *R.T. & J.Miller* 73, Grose River junction with Burrallow Creek, 8.iii.2007 (AD, NSW); *A.E.Orme* 396 & *R.Johnstone*, c. 0.8 km along Kedumba Valley firetrail from Queen Victoria Hospital, 18.x.2003 (AD, NSW); *C.L.Wilson* 502, Erskine Creek Road, Kings Tableland, 25.iii.1957 (NSW 85853/4); ?*Rev. Woolls* MEL35567, ?Parramatta, – (MEL).

Hibbertia marginata B.J.Conn

Muelleria 7: 294 (1990); G.J.Harden & J.Everett in G.J.Harden, Fl. New South Wales 1: 298 (1990). — *Type*: New South Wales: Mt Neville fire trail, Mt Marsh State Forest, *Hill* 2752, *Johnson & Weston*, 19.x.1987 (holo.: NSW206551).

Shrubs to 0.7 m tall, spreading, suckering; branches wiry becoming ± rigid-woody, with leaf bases scarcely decurrent, finely hirsute. *Vestiture* ± persistent, with longer over shorter, spreading to porrect simple hairs, those on the adaxial leaves pustulate. *Leaves* with intrapetiolar tuft up to 0.6 mm long; *petiole* 0.5–1 mm long; *lamina* oblong, oblong-elliptic, rarely oblong-lanceolate, (13–) 20–30 (–39.6) × (3.2–) 4–6.5 (–8.4) mm, ± abruptly constricted into petiole, obtuse to rounded with shortly recurved end of central vein, above ± flat but slightly depressed along the central vein with short pustulate simple hairs becoming longer and denser proximally and on the petiole, below almost flat with thin central vein and sparsely recurved margins exposing a broad undersurface between them, all sparsely hirsute with scattered fine erect longer and shorter simple hairs and with denser tuft of hairs on shortly recurved end of the central vein. *Flowers* sessile, single, terminal on main branches; *flower stalk* absent; *buds* ovoid; *primary bracts* oblong-lanceolate or rarely oblong, (4.3–) 5–8 (–11.2) × 1.8–3 (–4.2) mm, abruptly constricted apically and basally, leaf-like but flattened, with scarcely recurved margins, sparsely hirsute, additional bracts few, grading into cauline leaves. *Calyx lobes* unequal; *outer calyx lobes* ovate, rarely lanceolate, (10.3–) 12–15 (–20) × (5.5–) 6–7.5 mm, usually longer than inner ones, bluntly acute or obtuse, slightly ridged and with recurved margins distally, outside densely sericeous mainly proximally with many fine ± appressed simple hairs over few shorter ones, inside sericeous on distal half, dense proximally becoming sparser distally; *inner calyx lobes* oblong-ovate to broadly oblong,

(8.4–) 9–12(–13.8) × 5.6–7 mm, rounded to emarginate without ridge, outside densely sericeous except for broad membranous margins, inside glabrous. *Petals* oblong-obovate, 20–25 mm long, bilobed. *Stamens* 30–48, with many staminodes, surrounding ovaries; *filaments* strap-like, 4–4.9 mm long, distinctly broadened and basally connate into ring around the ovaries; *anthers* narrowly obloid, 1.8–3.8 mm long, abruptly constricted above and tapering into filaments. *Pistils* 3 (4); *ovaries* ovoid, each with 6 ovules, hirsute; *style* attached to apex and curved centrifugally outside the stamens and presenting the stigmas at level of but distant from anthers. *Fruit* and *seed* not seen. *Flowering*: September and October.

Distribution and ecology. Growing on sandy loam among sandstone outcrops in grassy understory of open eucalypt forest dominated by *Eucalyptus pilularis*, *E. intermedia* and *Angophora woodsiana* (Hill 2752), or *E. intermedia*, *E. microcorys*, *E. pilularis*, *Ceratopetalum gummiferum*, *Synoum glandulosum* (A.R.Bean 17939) in north-eastern New South Wales (NC).

Conservation status. “Locally frequent” (Hill 2752); “occasional at site” (A.R.Bean 17939).

Diagnostic features. *Hibbertia marginata* has close affinities to *H. vestita*, as unlike *H. saligna*, to which it has previously been compared (Conn 1990), it has densely hairy ovaries, numerous stamens with broadened filaments, many staminodes, spreading simple hairs on the branches and, significantly, pustulate hairs on the adaxial leaf surface. The leaf apex appears rounded, because the slightly protruding end of the central vein is somewhat recurved, as is typical of most species in the *H. vestita* subgroup. *Hibbertia marginata* is, however, easily distinguished from other species in that group by its long calyx lobes and leaves.

Variation. The number of stamens and staminodes varies considerably on different collections. The length of the anthers also varies greatly, even on the same flower. No intermediates between fertile stamens and the thread-like staminodes were observed.

The leaves and flower parts are much larger than any other species in this group and show an even larger range of variation than indicated in the description.

Specimens examined

NEW SOUTH WALES: A.R.Bean 17939, Range Road, Tabbinmobile State Forest, 15.ix.2001 (BRI); R.J.Fenshaw 4686, Mororo, NW Theka, 15.x.2001 (BRI); S.P.Phillips 1356 *et al.*, c. 5 km NNW Ashby, 24.ix.2001 (BRI).

Hibbertia mediterranea Toelken, sp. nov.

Hibbertiae vestitae similis sed ramis rigide lignosis, bracteis primariis lineari-lanceolata, filamentis filiformibus vix connatis; a H. expansa ramis rigide lignosis, foliis nervis centralibus angustis et recessis differt.

Type: Queensland, Mt Jibbinbar, Sundown National Park, WSW Stanthorpe, D.Halford Q2971, x.1996 (holo.: BRI-AQ654244).

Hibbertia vestita auct. non A.Cunn. ex Benth.: Jessup in Bostock & A.E.Holland, Census Queensl. Fl. 64 (2007), p.p.

Shrubs c. 0.4 m tall, much branched, stiffly erect-spreading; branches rigid-woody, with leaf bases scarcely decurrent, puberulous to pubescent, rarely pilose. *Vestiture* often wearing off, particularly on the leaves, with ± short erect simple hairs overtopped by longer simple ones. *Leaves* with sparse intrapetiolar tuft up to 0.3 mm long; *petiole* 0.2–0.5 mm long; *lamina* linear, (2.2–) 3.5–5 (–6.3) × 0.5–0.7 mm, abruptly constricted into petiole, acute to obtuse with end of central vein scarcely protruding, above convex puberulous to glabrescent even on the base and petiole and with insignificant pustules, below with broad revolute margins raised well above the narrow central vein so that the undersurface is not visible, puberulous on flanks of margins or sometimes with minute hairs on the central vein and its tip. *Flowers* sessile, single, terminal on main and shorter lateral branches; *flower stalk* absent; *buds* ovoid; *primary bracts* lanceolate, 2.8–3.2 × 0.6–0.8 mm, acute, leaf-like, flattened but without broadened undersurface, glabrescent, additional bracts 1 or 2, rarely grading into cauline leaves. *Calyx* lobes unequal; *outer calyx lobes* ovate, 7.2–8.2 × 4–4.4 mm, acute to pointed, with distinct central ridge and often with recurved margins distally, outside sparsely strigose to glabrescent, inside sparsely sericeous on distal third; *inner calyx lobes* ovate-oblong, 7.2–7.7 × 6.2–6.7 mm, acute to pointed, scarcely ridged, outside strigose along centre becoming sparsely sericeous towards the membranous margins, inside puberulous below the apex. *Petals* cuneate-obovate, up to 10.5 mm long, scarcely lobed. *Stamens* 30–38, staminodes present, loosely surrounding the ovaries; *filaments* filiform, 2–2.4 mm long, scarcely connate basally; *anthers* narrowly obloid, 1.8–2.6 mm long, abruptly constricted above, tapering into filaments. *Pistils* 3; *ovaries* obovoid, each with 4–6 ovules, hirsute to pubescent; *styles* attached to upper-outer edge of the ovaries and then erect with stigmas being presented well above the anthers. *Fruit* and *seed* not seen. *Flowering*: September and October.

Distribution and ecology. Grows “in Cypress sand” (B.C.Dodd s.n.) or in sandy loam, mid-slope, in the understory of eucalypt forest in southern mid-west Queensland (DD).

Conservation status. “Occasional” (D.Halford Q2971), but conserved in Sundown National Park.

Diagnostic features. *Hibbertia mediterranea*, although superficially similar to *H. vestita*, is easily distinguished by its rigid-woody spreading branches, densely rolled leaves, 1 or 2 small bracts without a broadened undersurface and, most importantly, thread-like filaments, which are scarcely connate basally. The protruding central vein at the tip of the leaves is usually not recurved, so that it resembles the condition in *H. expansa*. The leaves of that species have, however, a central vein

that is much broader than the revolute margins and more or less flush with them. The species also has wiry decumbent branches and long, more or less spreading hairs on the leaves; *H. expansa* was also recorded from Mount Jabbiner, cf. *D. Halford* 2733, *L. Hazelgrove* 189.

Variation. *B.C. Dodd s.n.* has many, longer antrorse appressed simple hairs on the branches, and hairs on the leaves are also longer and more like those of *H. expansa*, but the leaves as well as the bracts are tightly rolled.

When the revolute margins of the leaves, and especially the dorsiventrally compressed bracts, are drawn away from the central vein in herbarium specimens, they display fine rows of teeth or rudimentary hairs (cf. *H. stichodonta*). They are not tightly rolled leaves due to adverse environmental conditions as is found in some specimens of *H. vestita* (e.g. *S.T. Blake* 2676 & 3042), but even those specimens retain their expanded bracts (hypophylls) typical of the species.

Etymology. The epithet of this species refers to it being found "inland, remote from the sea" Latin "mediterranea".

Specimen examined

QUEENSLAND: *B.C. Dodd s.n.*, Inglewood Road (Tobacco Road), 7.x.1975 (BRI); *D. Halford* Q1868, 16.4 km S Inglewood, Tobacco Road, 12.xii.1992 (BRI).

Hibbertia pachynemidium Toelken, sp. nov.

Hibbertiae expositae similis sed filis brevioribus et semiconnatis foliisque sine tuberculis pilorum; a H. expositae foliis brevioribus ad 4.2 mm longis, nervis centralibus latis, protuberantibus et contiguus marginibus revolutis differt.

Type: New South Wales, *R. Pullen* 8557, S Big Badja Mountain, 31.x.1973 (holo.: CANB; iso.: MEL, NSW).

Shrublets up to 0.15 m tall, moderately branched, mat-forming; branches wiry, with scarcely decurrent leaf bases, pubescent to puberulous. *Vestiture* usually not persisting, with simple long and short hairs or long simple hairs over shorter forked ones; *on branches* moderately dense, with scattered longer antrorse simple hairs partly continued from the decurrent intrapetiolar tufts over denser but shorter forked hairs; *on leaves above* soon glabrescent, scattered antrorse simple hairs on \pm well developed basal pustules, becoming longer towards the margins and \pm spreading on the proximal flanks; *on leaves below* scattered antrorse simple hairs on the revolute margins but not on the central vein, usually with some (or rows of) teeth between the revolute margins and central vein; *on primary bracts* glabrous except for often incomplete marginal cilia and a dense tuft of simple hairs terminally; *on outer calyx lobes* outside glabrous to puberulous with scattered short appressed simple hairs mainly distally and often with a terminal tuft of often twisted or coiled hairs, inside denser, with mainly twisted antrorse simple over even finer forked hairs; *on inner calyx lobes* outside glabrous except marginal cilia or with scattered short appressed

mainly simple hairs especially dense on the mucronate apex, inside glabrous except for moderately dense antrorse appressed or twisted simple and some forked hairs on the distal third. *Leaves* with intrapetiolar tufts up to 0.6 mm long and \pm decurrent on sides of the leaf bases; *petiole* ca 0.2 mm long; *lamina* oblong-lanceolate to oblong-elliptic or rarely linear, (2.1–) 2.5–3.8 (–4.2) \times (0.5–) 0.6–0.8 (–1) mm, scarcely constricted into petiole, acute but projected into recurved end of vein with short tuft of hairs, above flat to slightly depressed along the central vein, with scattered pustulate simple hairs particularly along the flanks of the revolute margins, below with broad central vein protruding to flush with and tightly wedged between the revolute margins, with single hairs on the revolute margins and often few teeth or rows of teeth between the central vein and revolute margins. *Flowers* single, terminal on all branches, including the short axillary branches, which are not fascicled; *flower stalk* (2–) 3.5–5 (–9.5) mm long, with primary bracts towards the base; *buds* ellipsoidal; *primary bracts* linear-triangular, 1.8–2.3 \times c. 0.2 mm, acute with terminal tuft of hairs, dorsiventrally compressed and without revolute margins, incurved, glabrescent and margins ciliate, additional bracts 1–4 usually with fleshy revolute margins, grading into cauline leaves. *Calyx lobes* unequal; *outer calyx lobes* lanceolate, (3–) 4.5–5.8 (–6.1) \times (1.5–) 1.8–2.7 (–3.2) mm, acute or pointed and with terminal tuft, ridged, outside glabrous to puberulous, inside puberulous to pubescent below the apex; *inner calyx lobes* oblong-ovate to oblong-elliptic, (3–) 5.2–5.8 (–6.2) \times (1.5–) 1.9–3.3 mm, obtuse or cuspidate, rarely acute, scarcely ridged, outside glabrous or puberulous but terminally pubescent and with cilia, inside pubescent below apex. *Petals* oblong-ovate, (3–) 6–8 mm long, bilobed. *Stamens* 8–17, with staminodes, arranged around the ovaries; *filaments* strap-like, 1–1.2 mm long, broadened and connate basally; *anthers* broadly obloid, 0.5–1 mm long, abruptly constricted above but tapering below. *Pistils* 3; *ovaries* obovoid, each with 2 to 4 ovules, tomentose; *styles* attached to outer upper edge of ovaries, then curved out- and upwards with stigmas well above the anthers. *Fruit* and *seed* not seen. *Flowering:* October–November. **Fig. 2F–H.**

Distribution and ecology. Grows in eucalypt woodland with *Eucalyptus dives*, *Rytidosperma pallidum*, *Persoonia chamaepeuce*, *Allocasuarina nana* (*S.J. Forbes* 742) or *Eucalyptus pauciflora* and *E. dalrympleana* (*R. Pullen* 8557) in New South Wales (ST).

Conservation status. Unknown.

Diagnostic features. *Hibbertia pachynemidium* is similar to *H. exposita* particularly in habit and habitat, but distinguished by the shorter flower stalk, pronounced pustules on the leaves, glabrous outer calyx lobes (except for a tuft at the apex), and, most importantly, the broad-based connate filaments. Both these species differ

from *H. ericoides* and *H. intermedia* by their smaller flowers and shorter anthers.

The species is also similar to *H. vestita*, because of a similar androecium. The stamens are scarcely arranged in groups and the broadened filaments are often connate into a ring for more than half their length. The large number of staminodes is reminiscent of *H. vestita*, as well. The very broad central vein of the leaves and the generally smaller flowers without flat additional bracts, however, clearly distinguish *H. pachynemidium*.

Variation. Although the stalks of most flowers are longer than 10 mm, a few are very short and less than 4 mm. The buds are nodding, but, as no fruits have been seen, it is not known whether they too are recurved. One specimen, *J.D.Briggs & M.Parris 2078*, has all flowers sessile, but the very broad filaments and the many staminodes place it within this species.

A slightly more delicate form with glabrescent branches and smaller flowers has been recorded from near Bombala, but without detailed locality information (*W.Bäuerlen 305*). The flowers display the broadened filaments and a central vein that is broader than the revolute margins of the leaves.

Etymology. The epithet “pachy-nem-idium”, Greek, “diminutive broad thread” (a noun in apposition) refers to the unusually broadened filaments of the flowers of this species. This name bears no reference to the genus *Pachynema* R.Br. or *Hibbertia* subg. *Pachynema* (R.Br.) Horn.

Specimen examined

NEW SOUTH WALES: *W.Bäuerlen 305*, Bombala, – (MEL); *J.D.Briggs & M.Parris 2078*, Wadbilliga Natl Park, 28.x.1986 (CANB, MEL, NSW); *R.H.Cabbage NSW85880*, near Kybean Trig station, 4.xi.1908 (NSW); *S.J.Forbes 742*, 4.8 km NE Merriangah Peak, 31.x.1981 (MEL); *M.Parris CBG8604644*, Kybean River gorge, x.1971 (CANB); *J.H. Willis MEL119764*, Kydra Peak, 20.x.1948 (MEL).

Hibbertia pedunculata R.Br. ex DC.

Regn. Veg. Syst. Nat. 1: 430 (1817); Prodr. 1: 74 (1824); Lindl., Edwards’s Bot. Reg. 12, pl. 1001 (1826); Benth., Fl. Austral. 1: 32 (1863), p.p.; Gilg, Nat. Pflanzenfam. 3(6): 117 (1893), p.p.; C.Moore & Betche, Handb. Fl. New South Wales 10 (1893), p.p.; N.C.W.Beadle et al., Vasc. Pl. Sydney ed. 1, 195 (1963); G.J.Harden & J.Everett in G.J.Harden, Fl. New South Wales 1: 300 (1990), p.p.; Pellow, Henwood & Carolin, Fl. Sydney Region ed. 5: 126 (2009), p.p. — *H. pedunculata* R.Br. ex DC. var. *pedunculata*. Benth., Fl. Austral. 1: 32 (1863). — **Type:** New South Wales, near Port Jackson, *R.Brown s.n.* [J.J.Bennett 4865] (lecto. — **selected here:** G-DC; isoleccto.: BM, K); “in Nova-Hollandia, *Caley*” (syn.: not located, see typification).

Hibbertia corifolia Sims, Curtis’s Bot. Mag. 53, pl. 2672 (1826); Spach, Hist. Nat. Vég. Phan. 7: 421 (1839); Walp. Rep. Bot. Syst. 1: 64 (1842). — *H. pedunculata* var. *corifolia* (Sims) Benth., Fl. Austral. 1: 32 (1863). — **Type:** “We were favoured with the plant from which our drawing was taken, by our friend Robert Barclay, Esq. of Bury-Hill, who informs us that he received it from

Mrs. Marryatt of Wimbledon House. It was supposed to be from Nepal; but this is uncertain, and it seems more probably that its native country is New Holland.”, Curtis’s Bot. Mag. 53, pl. 2672 (lectotype — **selected here;** see typification).

Shrublets to 0.2 m high, spreading to decumbent, often with stout rootstock; branches wiry and up to 40 cm long, leaf bases decurrent, hirsute to scabrous when long hairs wear off. *Vestiture* largely persistent, with longer, often coarse simple hairs usually with basal tubercle over many to few short erect simple hairs often very dense on the calyx (rarely including a few forked hairs), often also with some hairs on the central vein of the leaves. *Leaves* with intrapetiolar tuft of hairs up to 0.6 mm long and usually decurrent along both sides of the leaf bases; *petiole* 0.2–0.6 mm long; *lamina* linear to linear-lanceolate, (1.8–) 3–7 (–9.8) × 0.4–0.6 mm, scarcely but abruptly constricted into petiole, acute becoming obtuse as end of vein with short tuft of hairs recurves, above convex, puberulous, pilose to glabrescent, below with moderately broad and recessed central vein proximally and usually touching the revolute margins and with rows of teeth along the interface, with undersurface not visible, puberulous to glabrescent. *Flowers* single, terminal mainly on larger branches; *flower stalk* 3–10 (–13.7) mm long, with primary bract usually subtending the calyx; buds broadly ellipsoidal to almost spherical; *primary bracts* linear, (1.2–) 1.4–1.8 (–2.2) × 0.2–0.4 (–0.5) mm, with ± recurved margins, acute to bluntly acute, rarely with few additional leaf-like bracts when flowers are born on short axillary shoots. *Calyx* lobes unequal; *outer calyx lobes* elliptic to elliptic-oblong, (3.8–) 4.3–4.8 (–5.3) × 1.8–2.6 mm, rounded, rarely bluntly obtuse, without distal central ridge, outside sparsely pilose, pubescent or puberulous, inside puberulous to glabrescent on distal third; *inner calyx lobes* broadly elliptic-oblong to elliptic-obovate, (4.2–) 4.5–5.3 × 2.8–3.3 mm, rounded to emarginate, scarcely ridged, outside scabrid-puberulous along the centre becoming appressed puberulous towards the membranous margins, inside scarcely puberulous below the apex. *Petals* obovate to oblong-obovate, up to 10 mm, bilobed. *Stamens* (14–) 18–35 (–43) and with ± staminodes, surrounding the ovaries; *filaments* filiform, 1.2–1.5 mm long, usually scarcely connate basally; *anthers* narrowly oblong, (0.8–) 1.2–1.6 mm long, papillate, abruptly constricted above and ± so below. *Pistils* (2) 3 (4); *ovaries* obovoid, each with 4 ovules, pubescent to hirsute; *style* recurved then erect and with erect to incurved stigmas well above the apex of the anthers. *Fruit* recurved, pubescent with mainly simple hairs. *Seeds* often obovoid, 1.4–1.5 × 1.2–1.3 mm, dark brown; aril with fleshy base surmounted by shallowly lobed membranous cup covering at least half of seed. **Flowering:** Mainly September–November.

Distribution and ecology. Grows in a wide range of habitats, but predominantly in clay soils with grassland understory under a wide range of eucalypt woodland and

recorded mainly from the central coast of New South Wales: mainly CC, but also NC (near Newcastle), CWS (?Rylstone).

Conservation status. Locally abundant (C.Driscoll 14, 17, 18), but generally infrequent to rare.

Diagnostic features. *Hibbertia pedunculata* is characterised by the presence of a range of mainly simple hairs (rarely some forked ones on the inner calyx lobes), primary bracts subtending the calyx and rounded outer calyx lobes with an indistinct central ridge in the distal portion.

Variation. Candolle (1817) recorded “stamens 12–13” for this species. This was queried by Sims (1826) in the discussion accompanying the description of *H. corifolia*. The lowest number of fourteen stamens found in this study was recorded in *J.Boorman NSW85898* from Bankstown, NSW. Most specimens seen of this species have distinctly more stamens, i.e. (14–) 18–35 (–43), and there are always a varying number of staminodes among them.

Plants are either multistemmed and sometimes, when older, they produce a few long wiry branches up to 40 cm long. Each branch has numerous axillary branches, but rarely these are so short that one might refer to them as short shoots with terminal flowers (e.g. see *M.Futter 304*). The leaves have a distinctly broadened central vein at least proximally, but in some extreme specimens the revolute margins are so strongly in-rolled that the central vein is no longer visible (e.g. *Mitchell NSW243238*).

Typification. *Hibbertia pedunculata* was based on Robert Brown’s unpublished concept as well as a specimen collected by George Caley. There are two specimens on the type sheet in G-DC, but the second specimen is inscribed “*Hibbertia thymifolia*” with “*pedunculata*” written across it. However more important is the inscription “m. Lambert 1818”, which could indicate that it is a Caley specimen received after publication of the species in 1817. No other Caley specimen identifiable as *Hibbertia pedunculata* has been located at G or G-DC. The Brown specimen agrees with de Candolle’s (1817) description, except that no modern specimen with less than 14 stamens has been seen (cf. variation). Label data on Robert Brown’s specimen (BM574315) at the National History Museum, London, gives the locality as “between Sydney + Parramatta / Sept 1803”, which agrees with Vallance et al. (2001).

A specimen at K inscribed “*Hibbertia corifolia* Sims Bot Mag t. 2672 — Hort Barclay 15.7.30” could be part of the type material, but was deposited at Kew at least four years after that species was described. The detailed illustration, with more than 13 stamens, in *Botanical Magazine* t. 2672 is preferable and is therefore selected as the lectotype of *H. corifolia*.

Specimens examined

NEW SOUTH WALES: *J.L.Boorman NSW85869*, Cundletown, x.1909 (NSW); *J.L.Boorman NSW85873*,

Wallsend, x.1899 (NSW); *J.L.Boorman NSW85891*, St Marys, ix.1920 (NSW); *J.L.Boorman NSW85898*, Bankstown, ix.1914 (AD, CANB, NSW); *R.H.Cabbage 828*, Peakhurst, xii.1902 (NSW); *J.H.Camfield NSW85889*, near Kogarah, x.1893 (NSW); *J.H.Camfield NSW85892*, Bexley, x.1893 (NSW); *E.Cheel NSW85870*, Manning River, xii.1899 (NSW); *C.Driscoll 13–18*, near Beresfield on Donaldson Coal mining lease, iv/v. 2002 (NSW); *R.W.Earp NSW85875*, Kilaben Bay, Lake Macquarie, iii.1956 (NSW); *O.D.Evans NSW85863*, Yennora, 13.x.1961 (NSW); *J.J.Fletcher NSW85893/4/5*, Cabramatta, 9.xi.1889 (NSW); *W.Forsyth NSW85876*, Wyong, 3.vi.1897 (AD, MEL, NSW); *M.Fuller 304*, Chester Hill, x.1927 (CANB); *C.P.Gibson s.n.*, Deverall Park at Condell Park, 26.x.2005 (AD, NSW); *C.P.Gibson 61*, Walshaw Park, Bass Hill, 12.x.2000 (AD, NSW); *C.P.Gibson 81*, Chullora Rail Yards, 9.x.2006 (NSW); *C.P.Gibson & R.T.Miller 24*, Smith Park, East Hills, xi.1988 (NSW); *C.P.Gibson & R.T.Miller 26*, Shaddock Ave, Villawood (extinct), 26.ix.1990 (AD, NSW); *A.A.Hamilton NSW85877*, Wyong, x.1913 (NSW); *A.A.Hamilton NSW85888*, Duck River, Clyde, 9.1914 (NSW); *J.King NSW85867*, Rylstone, 1953 (NSW); *N.King NSW243235*, Homebush, 1.ix.1891 (NSW); *S.King MEL1009762*, near Blue Mountains, 1893 (MEL); *J.H.Maiden NSW243239*, Homebush, x.1893 (NSW); *J.H.Maiden NSW243240*, St Marys Station, South Creek, 24.ix.1887 (NSW); *R.T.Miller s.n.*, Rookwood Cemetery, 16.x.2007 (AD, NSW); *R.T.Miller & C.P.Gibson 25*, Chullora Railway Yards, Muston site 3, 24.x.1990 (NSW); *R.T. & J.Miller, A. & A.Peters s.n.*, Woodlands Cottages, Cessnock, 24.iv.2010 (AD, NSW); *J.Mitchell NSW243238*, Newcastle, x.1904 (NSW); *H.Salasoo 1810*, Brantxton to Cessnock, 4.x.1959 (NSW); *Dr. Woolls NSW85879*, Kiandra, – (NSW); *W.Woolls MEL35562 & 35565*, Parramatta, – (MEL).

Hibbertia porcata Toelken, sp. nov.

A. H. samaria et H. singulari absentia pilorum stellatorum in ramis et lobis interioribus calicis et pagina infera foliorum glabra; a H. pedunculata calycis lobis externis acutis et porcatiss bracteisque ad basim pediceli differt.

Type: New South Wales, Lake George, *E.Gauba CBG4751*, 30.11.1949 (holo.: CANB; iso.: NSW).

Hibbertia pedunculata auctt. non R.Br. ex DC.: Benth., Fl. Austral. 1:32 (1863), p.p.; F.Muell., Syst. Cens. 1: 2 (1882), p.p.; F.Muell., Key Syst. Victoria Pl. 2: 5 (1885), p.p.; F.Muell., Second. Syst. Cens. 1: 2 (1889); A.A.Hamilton, Proc. Linn. Soc. New South Wales ser. 2, 2: 264 (1887); Ewart, Fl. Victoria 767 (1930), p.p.; N.T.Burb. & M.Gray, Fl. Australian Capital Territory 256 (1970); J.H.Willis, Handb. Pl. Victoria 2: 386 (1973), p.p.; G.J.Harden & J.Everett in G.J.Harden, Fl. New South Wales 1: 300 (1990), p.p.; Toelken in N.G.Walsh & Entwisle, Fl. Victoria 3: 304 (1996), p.p.

Shrublets often 0.25 (–0.45) m high, decumbent to prostrate; branches several, wiry- to rigid-woody, with decurrent leaf bases, pubescent to hirsute. *Vestiture on branches, leaves, flower stalk and calyx* persistent, with \pm dense longer spreading simple hairs (pustulate on leaves) over short simple ones. *Leaves* with dense intrapetiolar tufts of hairs up to 1 mm and usually decurrent on both sides of the leaf bases; *petiole* 0.3–1.2 mm long; *lamina* linear-lanceolate to linear, (1.3–) 4–6 (–7.4) \times 0.5–0.7 (–0.8) mm, usually scarcely constricted into petiole, acute often becoming obtuse, with apex of central vein

usually scarcely protruding, recurved and with short tuft of hairs, above flat, sparsely hirsute to glabrescent, rarely pilose, but scattered basal pustules visible, below with slender recessed central vein overtopped by revolute margins and rarely with rows of teeth between them, with glabrous undersurface rarely visible, similarly hirsute to glabrescent as above. *Flowers* single, terminal on main and lateral branches, with rounded base; *flower stalk* (2–) 4–10 (–16.8) mm long, with primary bracts usually towards the base or rarely up to the middle; *buds* broadly ovoid to ellipsoidal; *primary bracts* linear, linear-lanceolate, (1.3–) 4–6 (–7.8) × (0.4–) 0.5–0.8 (–1) mm, acute, leaf-like with distinctly revolute margins at least distally, usually glabrescent; additional bracts (0) 1–3, with more pronounced revolute margins, grading into cauline leaves. *Calyx* lobes unequal; *outer calyx lobes* lanceolate to lanceolate-elliptic, (5–) 6–7 (–7.8) × (1.2–) 1.4–1.8 mm, often ± longer than inner ones, acute, with central ridge usually well developed usually along the full length, outside hirsute to strigose, inside pubescent to puberulous on distal third; *inner calyx lobes* broadly ovate to oblong-elliptic, (4.6–) 5.5–6.8 (–7.3) × (2.6–) 2.8–3.3 mm, rounded to mucronate or emarginate, slightly ridged, outside strigose along the central ridge and pubescent to puberulous towards the membranous margins. *Petals* broadly obovate, up to 11.7 mm long, bilobed. *Stamens* 15–25, rarely with few staminodes, arranged around the ovaries; *filaments* filiform to strap-like, 1.6–3 mm long, broadened but usually scarcely connate basally; *anthers* obloid, 1.1–1.6 mm long, above abruptly constricted, below tapering into the filaments. *Pistils* 3; *ovaries* obovoid, each with 4–6 ovules, hirsute; *style* attached to the upper outer margin of the ovaries, then curved upwards and ± erect and with stigmas above the anthers. *Fruit* recurved, hirsute. *Seeds* obloid-obovoid to comma-shaped, 2.6 × 1.8 mm, dark brown; *aril* with oblique fleshy attachment surmounted by a membranous cup covering more than a third of one side of the seed. *Flowering*: October–December (April, May).

Distribution and ecology. Recorded from various substrates, but usually on sandstone or other rock types, often associated with heath-like understory in eucalypt woodland in New South Wales (CT, ST, SWS) with a single record from Victoria (MID).

Conservation status. Widespread but apparently never common. Recently described as “locally rare” (A.R.Bean 15798, R.Johnstone 1717 & A.E.Orme).

Diagnostic features. *Hibbertia porcata* is a very variable species known from many isolated populations. It is easily recognised by the usually pronounced ridge along the length of the outer calyx lobes, accentuated by recurved distal margins. The long simple hairs on the calyx, especially on the outer calyx lobes usually have pronounced basal tubercles. It has a glabrous, usually granulate leaf undersurface, mainly visible on bracts and on prophylls at the base of lateral branches, and the anthers are usually longer than 1.5 mm. The ± linear

leaves with long simple hairs resemble those of *H. samaria*, but *H. porcata* differs by having only simple hairs on all parts of the plants (or rarely the odd forked hair on the inner calyx lobes) and the undersurface of the leaves is glabrous or rarely with a few fine teeth on the (revolute) leaf margins. *Hibbertia porcata* shares vestiture and the large flowers with many stamens with *H. pedunculata*, but is distinguished by its acute to pointed outer calyx lobes with a pronounced central ridge. It also usually has a very much broader central vein than the revolute margins at mid-leaf, and occurs mainly in inland localities more or less skirting the northern and north-western subalpine regions, whereas *H. pedunculata* is mainly restricted to the coastal regions of central and northern New South Wales. Similarly, sessile-flowered specimens of *H. porcata* from, for instance, Tumut (cf. *Variation* below) have sometimes been identified as *H. vestita*, a species from the coast of northern New South Wales and southern Queensland. These are mainly distinguished by their broader central vein, which is more or less tightly wedged in between the revolute margins.

Variation. The length of leaves and hairs varies greatly in different populations in this species, as is commonly found in species of this group. The most noteworthy variation, sessile or subsessile flowers found in three specimens from the vicinity of Tumut (e.g. J.L.Boorman NSW85881), also affects the concept of the *H. pedunculata* subgroup, which is mainly distinguished by stalked flowers. Specimens from further south, viz. Tumbarumba (e.g. E.J.McBarron 787) and Khancoban (E.Dakin MEL695441), however, have stalked flowers. Furthermore, records from the northern parts of the distribution, especially from north of Orange (e.g. A.R.Bean 15798) also have subsessile flowers, as well as a more erect habit (in one case up “to 45 cm high, apparently decumbent on other plants”, R.Johnstone 1717 & A.E.Orme). Some of these specimens also have a larger number of stamens or finer hairs on the whole plant, but all these extreme characters occur in plants from populations peripheral to the main distribution of the species.

Most astonishing is the only collection of this species from Victoria, viz. from Christmas Hills, north-east of Melbourne (D.Rouse 1). More collections of this species throughout its range are needed in order to evaluate the morphological variation discussed above.

Etymology. The apex of the outer calyx lobes is distinctly ridged and usually this ridge is accentuated by two grooves on either side due to the somewhat recurved distal margins. The epithet “porcata” Latin “ridged”, from “porca” “the ridge between two furrows made in plowing” refers to this resemblance of the distal outer calyx lobes.

Voucher specimens

NEW SOUTH WALES: A.R.Bean 15798, 3 km W Mullion Creek, N Orange, 19.xi.1999 (BRI, NSW); J.L.Boorman

NSW85881, Gilmore near Tumut, x.1916 (NSW); *C.Burgess* CBG56281, Napoleon Reefs, 16.1 km E Bathurst, 19.xi.1970 (CANB); *E.Dakin* MEL695441, Khancoban, 30.x.1949 (MEL); *R.G.Garland* MEL1009778, Tumut River, 1887 (MEL); *W.Hunter* MEL35584, spur near Berrima River, v.1939 (MEL); *R.Johnstone* 1717 & *A.E.Orme*, near Pagoda Lookout, Wollemi National Park, 16.xii.2005 (NSW); *B.Lane* NSW85864, Mullion Range State Forest, c. 14 km N Orange, 29.xi.1960 (NSW); *MacGillivray* AD98587233, Hill End, 3.i.1925 (AD); *J.H.Maiden* & *J.L.Boorman* NSW85884, Tumut, viii.1903 (NSW); *E.J.McBarron* 787, Tumberumba, 5.iv.1947 (NSW); *E.J.McBarron* 5342, Munderoo South, Tumberumba, 12.xi.1950 (NSW); *A.Morris* NSW85866, Hill End, 3.i.1925 (NSW); *F.Mueller* MEL1009677, Towong, 1874 (MEL); *R.J.Norland* NSW85882, Tumut to Tumberumba, xii.1947 (NSW); *L.Pryor* CANB256221, Tumut, 1937 (CANB); *R.Pullen* 1313, SE Greenwood Trig., Sutton to Queanbeyan Road, 26.iv.1959 (CANB); *s. coll.* 57, Wagga Wagga, i.1896 (NSW); *Walker* ANU1215, west of Sutton Road, near ACT Border, xii.1963 (CANB, NSW); *N.G.Walsh* 7402 & *K.L.McDougall*, c. 1 km S Murray Jackson Drive from Talbingo turnoff, 16.xi.2011 (MEL); *J.E.Ward* 173, 30 km from Yass to Bevendale, between Blakney Creek and Blomfield homestead, 14.xi.1985 (CANB).

VICTORIA: *D.Rouse* 1, Christmas Hills (AD, MEL).

Hibbertia samaria Toelken, sp. nov.

Hibbertia porcatae similis sed pilis fasciculatis in ramis et lobis interioribus calicis et pagina infera foliorum glabra; a *H. singulari foliis longioribus et pilis longis effusis nervisque centralibus recessis*; a *H. humilis* subsp. *erigens* staminibus circum ovaria dispositis differt.

Type: Victoria, Mt Samaria Road, c. 5 km NW Bridge Creek, *I.C.Clarke* 2737, 12.xi.1996 (holo.: AD; iso.: BRI; CANB, MEL2037060 – n.v.).

Hibbertia serpyllifolia auctt. non R.Br. ex DC.: Benth., Fl. Austral. 1: 32 (1863), p.p. quoad *F.Mueller* MEL35583, ranges on the McAlister River; *F.Muell.*, Native Pl. Victoria: 17 (1879), “*serpyllifolia*”, p.p.; *F.Muell.*, Syst. Cens. 1: 2 (1882), p.p.; *F.Muell.*, Key Syst. Victorian Pl. 1: 122 (1887), “*serpyllifolia*”, p.p.; Ewart, Fl. Victoria 767 (1930), p.p.

Hibbertia pedunculata auctt. non R.Br. ex DC.: J.H.Willis, Handb. Pl. Victoria 2: 386 (1973), p.p., quoad *F.Mueller* MEL35583, ranges on the McAlister River; Toelken in N.G.Walsh & Entwisle, Fl. Victoria 3: 304 (1996), p.p.

Hibbertia sp. 1 (Eastern Highlands) N.G.Walsh & V.Stajsic (2007), Census Vasc. Pl. Victoria ed. 8: 80 (2007).

Shrublets up to 0.15 m tall, multi-stemmed, decumbent or mat-forming, rarely tufted; branches wiry, becoming rigid towards the base, up to 30 cm long and with many short axillary branches each usually with a terminal flower, with leaf bases scarcely decurrent, hirsute. *Vestiture* persistent, with spreading long, usually antrorse simple hairs often over fascicled hairs on all parts; *on branches* moderately dense, with \pm spreading long antrorse simple hairs over multiangular fascicled hairs (3–5 often unequal arms); *on leaves above and below* sparse, with longer and shorter antrorse simple hairs on usually scarcely pronounced basal pustules and becoming dense on the terminal end of the vein; *on bracts* similar to leaves but much sparser and without pustules; *on outer calyx lobes* outside moderately dense,

with coarse long simple hairs mainly along the central ridge and distally over scattered shorter ones, inside moderately dense, with fine antrorse fascicled hairs (3–5 often unequally long arms) on the distal half; *inner calyx lobes* outside dense, with scattered coarse antrorse simple hairs mainly along the central ridge overtopping usually multiangular fascicled hairs (2–6 subequal arms) covering much of the surface up to the membranous margins, inside a cluster of fine short fascicled hair below the apex. *Leaves* with intrapetiolar tufts up to 0.6 mm long, often unequally long and shortly decurrent along the leaf bases; *petiole* 0.2–0.6 (–1) mm long; *lamina* linear, rarely linear-elliptic, (2.8–) 4–7 (–13.6) \times (0.8–) 1–2 (–2.3) mm, gradually tapering into petiole, acute with short straight end of vein rarely recurved and with tuft of hairs, above flat to slightly depressed along the central vein, sparsely pubescent to almost pilose, below with recessed moderately broad central vein often separate from revolute margins and displaying the fascicled-tomentose undersurface, sparsely pilose. *Flowers* single, terminal on main branches but also common on short axillary branches along the main ones; *flower stalk* (3–) 5–12 (–20.4) mm long, with primary bracts towards the base; *buds* broadly ovoid; *primary bracts* linear-lanceolate to linear-elliptic, 1.5–2 (–3.8) \times 0.4–0.6 mm, acute and sometimes with recurved apex, dorsiventrally compressed and with recurved margins, puberulous except for tufted apex; additional bracts 1 or 2, small, leaf-like and on short shoots often not merging into cauline leaves. *Calyx lobes* unequal; *outer calyx lobes* ovate, (5.2–) 5.8–6.5 (–7.7) \times 2.6–2.8 (–3.1) mm, acute to pointed, with central ridge \pm obscured by strigose vestiture on outside, inside sericeous; *inner calyx lobes* ovate-oblong to oblong-elliptic, (5.2–) 5.8–6.2 (–7.2) \times 3.5–4 (–4.5) mm, acute to cuspidate, scarcely ridged, outside pubescent, inside finely tomentose below the apex. *Pistils* 3; *ovaries* obovate, up to 15.8 mm long, bilobed. *Stamens* 10–15, without staminodes, arranged around the ovaries; *filaments* filiform, 1.4–1.6 mm long, scarcely basally broadened and connate; *anthers* obloid, 1.5–2 mm long, abruptly constricted above, tapering into filament below. *Pistils* 3; *ovaries* obovoid, each with 4–6 ovules, fascicled-hirsute; *styles* attached to outer upper edge of ovaries, then curved up and exposing the stigmas well above the anthers. *Fruit* recurved, shortly fascicled-hirsute. *Seeds* obloid-obovoid, 2–2.2 \times 1.4–1.7 mm, brown; *aril* with somewhat lateral attachment slightly fleshy and surmounted by scarcely lobed membranous cup covering less than a third of the seed. *Flowering:* October and November (May).

Distribution and ecology. Growing in usually rocky situations or on rock slabs and/or in sparse grassy understorey in dry sclerophyll forest of *Eucalyptus macrorhyncha* and *E. goniocalyx* (*I.C.Clarke* 2737) in the south-western part of the Eastern Highlands (EHL), Victoria.

Conservation status. Widespread through Mt Samaria State Park (A.D.J.Piesse 268).

Diagnostic features. Although this species is very similar to *H. porcata*, it is easily distinguished by the presence of multiangular fascicled hairs on the inner calyx lobes, but also often on the branches and, significantly, on the undersurface of leaves, wherever exposed. The large flowers and the occurrence of fascicled hairs on the branches and on inner calyx lobes resemble those of *H. singularis*, from which *H. samaria* differs by its longer leaves covered with spreading simple hairs.

Variation. The size of the flowers, i.e. the calyx and corolla, varies considerably from larger ones on terminal main branches to smaller ones on the axillary branches and especially on fascicled axillary branches (A.C.Beauglehole 91076 & N.J.Rossiter). Often the length of the flower stalk and of the accompanying bracts varies accordingly.

The central vein varies from narrow and almost as thick as the revolute margins to distinctly broader than the revolute margins but scarcely raised above the undersurface (I.C.Clarke 2737).

Note. Bentham (1863) did not specifically cite the specimen "F.Mueller, ranges of the Mc Alister River", although he had examined it and signed the collector's label. The specimen at K is signed "H. serpyllifolia R.Br." in red by Bentham. A second specimen collected by F.Mueller from Mt Ligar was not annotated by him. The two specimens may indicate a wider distribution of the species.

Etymology. The epithet "samaria" (a noun in apposition) is derived from Mt Samaria State Park in Victoria, from where several specimens of the species were recorded. It bears no reference to the biblical origin of the name.

Specimens examined

VICTORIA: A.C.Beauglehole 91076 & N.J.Rossiter, Mt Samaria State Forest, 7.xi.1987 (CANB, MEL119768); W.Cane sub A.C.Beauglehole 9933, Heyfield, 1960 (MEL); E.A.Chesterfield 1301, Long Hill, McAlister River catchment, 6.xii.1973 (MEL); E.A.Chesterfield 1320, Breakfast Creek, Wellington River catchment, 16.xii.1973 (MEL); I.C.Clarke 2737, c. 5 km NW Bridge Creek, Mt Samaria Road, 12.xi.1996 (MEL); J.A.Jeanes 2541, Mt Samaria Road, c. 4.1 km from Blue Range Creek, 24.1.2011 (MEL); F.Mueller MEL35581, Mt Ligar, – (MEL); F.Mueller MEL35583, ranges on the MacAlister River, – (K, MEL); A.D.J.Piesse 268, 19 km N Mansfield to West Track, Mt Samaria State Park, 28.v.1986 (MEL); P.G.Smith MEL574738, Mt Samaria State Park, 25.x.1978 (MEL).

Hibbertia serpyllifolia R.Br. ex DC.

Regn. Veg. Syst. Nat. 1: 430 (1817); DC., Prodr. 1: 74 (1824); Spreng., Linn. Syst. Veg. ed. 16, 2: 614 (1825); G.Don., Gen. Hist. 1: 76 (1831); Steud., Nomencl. Bot. ed. 2, 1: 757 (1840); Benth., Fl. Austral. 1: 32 (1863), p.p. quoad typum; F.Muell., Native Pl. Victoria: 17 (1879), "serpyllifolia", p.p.; F.Muell., Syst. Cens. 1: 2 (1882), p.p.; C.Moore, Cens. Pl. New South Wales: 1 (1884), p.p.; F.Muell., Key Syst. Victorian Pl. 1: 122 (1887),

"serpyllifolia", p. p.; Gilg, Nat. Pflanzenfam. III(6): 117 (1893), p.p.; C.Moore & Betche, Handb. Fl. New South Wales 10 (1893), p.p.; A.Hamilton, Proc. Linn. Soc. New South Wales 24: 354 (1899), p.p.; Rodway, Tasmanian Fl. 4 (1903); N.C.W.Beadle et al., Vasc. Pl. Sydney ed. 2: 230 (1972), p.p.; J.H.Willis, Handb. Pl. Victoria 2: 386 (1973), p.p.; N.C.W.Beadle, Stud. Fl. N.E. New South Wales 3: 253 (1976), p.p.; G.J.Harden & J.Everett in G.H.Harden, Fl. New South Wales 1: 300 (1990), p.p.; Toelken in N.G.Walsh & Entwisle, Fl. Victoria 3: 304 (1996), p.p.; Pellow, Henwood & Carolin, Flora Sydney Region ed. 5: 126 (2009), p.p. — **Type:** Queensland, Shoalwater Bay Passage [Westall Hill], R.Brown [J.J.Bennett 4866], 26.viii.1802 (holo.: G-DC; iso.: BM, K).

Hibbertia vestita auct. non A.Cunn. ex Benth.: Jessup in Bostock & A.E.Holland, Census Queensland Fl. 64 (2007).

Shrublet usually to 0.5 m, but also up to 1 m tall, multi-stemmed from woody rootstock, moderately branched, erect-spreading to decumbent; branches wiry- becoming rigid-woody, with decurrent leaf bases, pubescent to hirsute. *Vestiture* usually a mixture of short and longer simple hairs without tubercles or obvious pustules on leaves, often wearing off; *on branches* sparse to dense, with antrorse and often \pm appressed longer over more erect shorter simple hairs; *on leaves above* scattered, with very short antrorse simple hairs particularly on the proximal adaxial surface and flanks of the revolute margins, often wearing off; *on leaves below* sparse, with shorter and longer short \pm antrorse-appressed simple hairs mainly along the central vein but sometimes also on the revolute margins, with exposed glabrous undersurface; *on bracts* above and below sparse, with scabrid to appressed very short antrorse hairs; *on outer calyx lobes* outside sparse to scattered, with longer over shorter spreading simple hairs up to 0.3 mm long mainly on the proximal parts, inside glabrous or with few scattered simple hairs below the apex; *on inner calyx lobes* outside sparse with short antrorse \pm appressed hairs mainly along the centre, inside glabrous except for few distal hairs. *Leaves* with sparse intrapetiolar tufts of hairs up to 0.5 mm long; *petiole* 0.2–0.5 mm long; *lamina* oblong to oblong-elliptic, (2.6–) 4–8 (–9.6) \times (0.7–) 1–2 (–2.7) mm, abruptly constricted into petiole, obtuse to rounded with recurved mucro bearing shortly tufted hairs, above convex but often with \pm slight depression along the central vein and puberulous, glabrescent or glabrous, below with prominent but narrow puberulous revolute margins well above the scarcely raised and narrow puberulous central vein exposing between them much of the glabrous undersurface. *Flowers* single, \pm sessile, terminal on main and lateral branches; *flower stalk* up to 4 mm, with primary bracts usually subtending the calyx; *buds* ovoid; *primary bracts* oblong-elliptic to oblong-oblancoate or spatulate, (1.2–) 2.5–3 (–3.4) \times (0.2–) 0.4–0.5 mm, acute, flat and leaf-like with central vein and revolute margins \pm developed; additional bracts 2–4, usually not merging into cauline leaves. *Calyx lobes* unequal; *outer calyx lobes* lanceolate, (4.2–) 5.5–7.5 (–8.4) \times (1.8–)

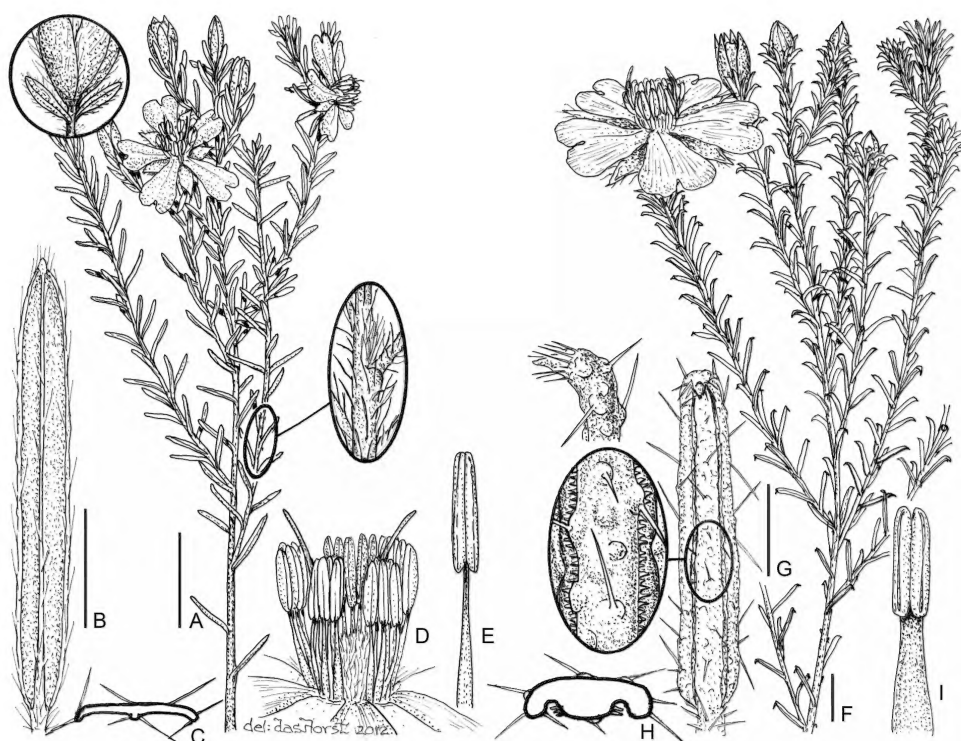


Fig. 3. A–E *H. serpyllifolia*: **A** flowering branch; **B** abaxial view of flat leaf; **C** transverse section through mid-leaf; **D** flower without calyx and corolla; **E** stamen with filament slightly broadened basally. **F–I** *H. stichodonta*: **F** flowering branch; **G** abaxial view of leaf with recurved apex and rows of teeth between the central vein and revolute margins; **H** transverse section through mid-leaf; **I** stamen with filament much broadened basally. — Scale bars: **A, F** 10 mm; **B, G** 2 mm. — **A–E** G.H.Gittins 1207, **F–I** R.Grant-Newman s.n.

2.6–3.7 mm, acute and apex usually \pm recurved, with central ridge, outside sparsely pubescent to puberulous, inside puberulous to glabrous distally; *inner calyx lobes* ovate to oblong-ovate, (5.3–) 5.5–7 (–7.6) \times 3–4 (–4.6) mm, bluntly acute to obtuse, scarcely ridged, with membranous margins, outside puberulous to glabrous, inside glabrescent. *Petals* obovate, up to 12 mm long, \pm bilobed. *Stamens* (8–) 12–20 (–24), without staminodes, in groups around ovaries; *filaments* filiform, 1.3–1.6 mm long, broadened towards the base but scarcely basally connate in groups; *anthers* slender obloid, (1.8–) 2–2.2 mm long, subequal, abruptly constricted above and below. *Pistils* 3; *ovaries* obovoid, with 4 ovules, hirsute; *style* attached to the outer upper apex then curved outward and spreading with stigmas borne at \pm same level but centrifugally distant from anthers. *Fruit* erect, hirsute with simple hairs. *Seeds* broadly obovoid, 1.6–1.8 \times 1.7–2 mm, black to dark brown; aril with fleshy attachment surmounted by an irregularly lobed membranous cup covering the lower third to half of the seed. *Flowering*: (May) July–October. **Fig. 3A–F.**

Distribution and ecology. Grows usually on sandy soils mainly in heath in wallum country but also in grassland

or as undercover in coastal forests in mid-northern Queensland (PC).

Conservation status. Localised, but conserved on North Keppel Island and in Byfield National Park.

Diagnostic features. *Hibbertia serpyllifolia* is usually easily distinguished from *H. vestita* by the glabrescent outer calyx, absence of staminodes, large variation in anther length, commonly shrubby habit, and by the antrorse and often more or less appressed hairs on the branches. The usually broadly oblong to elliptic leaves, each with scarcely revolute margins and a narrow, scarcely raised central vein, are also distinctive, but, as they sometimes roll as tightly as in the very similar *H. vestita*, this character can generally not be observed on herbarium specimens.

The glabrous undersurface of the leaves is usually widely exposed between the narrow central vein and scarcely revolute margins, as in *H. ericifolia* subsp. *acutifolia*. *Hibbertia serpyllifolia* is distinguished by leaves with a scarcely broadened central vein, rounded leaf apices, linear to linear-triangular primary bracts

(linear-oblongate to spatulate in *H. ericifolia*) and longer anthers.

Variation. On several specimens the habit is described as spreading shrubs to 50 cm high, but *E.R.Anderson* 3565 mentions plants reaching 1 m tall in a young pine plantation. In coastal localities plants tend to have a decumbent habit (*G.N.Batianoff* 708 & *T.J.McDonald*; *P.R.Sharpe* 4720 & *R.Leggatt*). Similar large variation for the shape and size of leaves is presumably largely due to the amount they have rolled in extreme environmental conditions (as has been recorded in *M.M.Davis* 6). On “wind shorn heath” the size of the flowers is very much smaller and they produce only eight stamens (*P.R.Sharpe* 4720 & *R.Leggatt*).

The central vein on the abaxial leaf surface is scarcely raised, similar to leaves of *H. vestita*, but the whole leaf of *H. serpyllifolia* is usually broader, as the lamina rarely rolls as tightly as in *H. vestita*. The margins of leaves of *H. serpyllifolia* are often scarcely revolute, so that the difference between extreme specimens with rolled and unrolled leaves is quite spectacular (e.g. see *M.M.Davis* 6).

Note. Bentham (1863) combined *H. serpyllifolia* with *H. ericifolia*. Although the holotype of *H. serpyllifolia* (G-DC) is very small, it can easily be distinguished from the very similar *H. ericifolia* by the small spatulate bracts with an obtuse to rounded apex and the central vein protruding from the obtuse apex of leaves. The specimen of this collection at BM bears a label reading “*Cistoides serpyllifolia* desc. [...] Shoalwater bay passage / Aug 26.1802”, indicating it refers to the tropical species, which is restricted to a small area along the central coast of Queensland.

Specimens examined

QUEENSLAND: *E.R.Anderson* 3029, Upper Stony Creek, Byfield State Forest, 9.v.1982 (BRI); *E.R.Anderson* 3565 & 3566, c. 4 km N Byfield, 5.x.1983 (BRI); *G.N.Batianoff* 708 & *T.J.McDonald*, Water Park Creek, 24 km N Yeppoon, 10.ix.1977 (BRI, CANB, K); *A.M.Buchanan* 6890, Upper Stony Creek, BSF, 31.v.1985 (BRI); *J.R.Clarkson* 695 & *T.D.Stanley*, Shoalwater Military reserve, 6.vii.1977 (BRI); *M.M.Davis* 6, roadside near Byfield, viii.1970 (BRI, CANB); *C.H.Gittins* 1207, 22 miles [35.2 km] N Yeppoon, viii.1966 (BRI); *P.Hind* 2401, Water Park Creek, 23.vii.1979 (NSW); *P.Hind* 2647 & *J.Forlonge*, Water Park Creek before picnic area, Bowen State Forest, 27.viii.1980 (NSW); *A.C.Robinson s.n.*, Waterpark Creek, 6.i.1975 (BRI); *P.R.Sharpe* 4720 & *R.Leggatt*, c. 2 km N Monkey Point, North Keppel Island, 2.ix.1988 (BRI); *N.H.Speck* 1764, 18 miles [28.8 km] N Yeppoon, 2.ix.1963 (AD, K, MEL, NSW); *M.B.Thomas* 176, headland above Monkey Point, North Keppel Island, 3.ix.1987 (BRI); *C.T.White* 8043, Byfield, 23.ix.1931 (BRI).

Hibbertia singularis Toelken, sp. nov.

Hibbertiae porcatae et *H. samaria* similis sed foliis brevioribus et nervo centrali latiore et protuberanti; a *H. pachynemidio* lobis calicis longioribus staminibusque 22–25 et staminodiis multis differt.

Type: New South Wales, Kydra Peaks, *J.H.Willis* MEL119765, 11.i.1970 (holo.: MEL).

Shrublet to 0.15 m tall, decumbent, much branched; branches wiry but soon becoming rigid, with leaf bases shortly decurrent, pubescent. *Vestiture* soon wearing off, sparse with mainly fine simple hairs except for some fascicled hairs on the branches; *on branches* sparse and wearing off soon, scattered short antrorse simple hairs mainly decurrent from the intrapetiolar tufts, over minute fascicled hairs (2–4 subequal branches) mainly restricted to the grooves between the leaf bases; *on leaves above and below* rarely with very short antrorse simple hairs on or only with pustules mainly along the flanks of the revolute margins, and a short tuft of simple hairs on distal end of central vein; *on primary bracts* sparse but usually persisting, with fine antrorse simple hairs without pustules usually appressed except along the flanks of the revolute margins, and with distal tuft; *on outer calyx lobes* outside, sparse to moderately dense distally, with fine usually appressed antrorse simple hairs and \pm ciliate or often slightly crisped on and around the apex, inside with fine appressed antrorse simple hairs on the distal third; *on inner calyx lobes* outside with scattered short antrorse simple hairs becoming forked to fascicled hairs towards the apex except for a row of longer \pm spreading simple hairs on the distal ridge and apex, inside a cluster of very short forked or fascicled hairs below the apex. *Leaves* with intrapetiolar tufts up to 0.6 mm long and \pm decurrent on both sides of the leaf bases; *petiole* 0.2–0.4 mm long, often indistinct; *lamina* oblong-elliptic, rarely oblong-lanceolate, (1.5–) 2–3.5 (–4.2) \times (0.6–) 0.7–1 mm, scarcely tapering into petiole, obtuse, with apex scarcely recurved and sparsely hairy, above flat, sparsely sericeous but soon wearing off leaving pustules mainly on the revolute margins, below with very broad central vein usually flush with and wedged tightly in between the revolute margins, sparsely sericeous soon wearing off. *Flowers* single, terminal mainly on major branches; *flower stalk* (9.8–) 10.5–16 (–22.4) mm long, with primary bracts towards the base; *buds* broadly ellipsoidal, rarely broadly ovoid; *primary bracts* linear-lanceolate, 2.5–2.8 \times 0.4–0.55 mm, acute, without revolute margins, \pm incurved, puberulous; additional bracts (0) 1–3, leaf-like, grading into cauline leaves. *Calyx lobes* subequal; *outer calyx lobes* ovate, (5.5–) 6–7.5 (–9.3) \times (2.6–) 3–4.2 mm, acute to pointed, slightly ridged, outside sparsely pubescent or puberulous, inside pubescent on distal half; *inner calyx lobes* broadly oblong-ovate, (5.6–) 6–7.5 (–8.8) \times 3.5–4.8 mm, acute to cuspidate, scarcely ridged, outside puberulous to pubescent distally, inside shortly tomentose below the apex. *Petals* obovate, up to 9.8 mm long, bilobed. *Stamens* 22–25, with as many staminodes, arranged around the ovaries; filaments filiform, 1.8–2.1 mm long, scarcely connate basally; *anthers* obloid, 0.9–1.2 mm long, above abruptly constricted, below gradually tapering into filaments. *Pistils* 3; *ovaries* obovoid, each with 4 ovules, sparsely hirsute; *styles* attached to the upper outer end of the ovaries, then curved upwards and bearing the stigmas well above the anthers. *Fruit*

recurved, sparsely hirsute with simple hairs. *Seeds* obovoid, $2\text{--}2.3 \times 1.8\text{--}2$ mm, dark brown; *aril* attachment fleshy and slightly to one side and surmounted by a \pm lobed membranous cup covering about one-third of the seed. *Flowering*: January.

Distribution and ecology. Known only from Kydra Peaks in New South Wales (ST).

Conservation status. Unknown.

Diagnostic features. Although superficially similar to *H. porcata* and especially *H. samaria*, the small, usually glabrous (except for pustules) leaves with a very broad central vein flush with or protruding above the revolute margins, shorter anthers, as well as the numerous staminodes, easily distinguish *H. singularis*. Its leaves and the tomentum of the branches also closely resemble those of *H. pachynemidium*, which occurs on nearby mountains, but *H. singularis* is distinguished by much larger flowers (outer calyx lobes $(5.5\text{--}) 6\text{--}7.5$ $(\text{--}9.3) \times (2.6\text{--}) 3\text{--}4.2$ mm), more stamens and numerous staminodes, the anthers being more uniform and longer ($0.9\text{--}1.2$ mm) and by filaments that are scarcely connate basally and less widened towards the base than is commonly found in the *H. vestita* group.

Variation. The specimen examined shows an exceptionally wide range in the length of the calyx lobes, possibly because the collection, with only one flower and several in various stages of fruiting, exhibits a strongly accrescent habit common in the *H. pedunculata* subgroup. The effect is probably accentuated here because the specimen was collected late in the flowering season. This, however, does not mean that *H. singularis* is merely a well grown mature plant of *H. pachynemidium*, as larger leaves would be the first indicator of such a change, but the size and shape of the leaves are remarkably similar in the two species. Critical for distinguishing the two species are the number of stamens and staminodes as well as the shape and size of the filaments.

Etymology. Although only a single collection of this species was examined, it is so different from the closest species, *H. pachynemidium* and *H. porcata*, that it is considered "alone of its kind", Latin "singularis".

Specimens examined.

Known only from the type specimen.

***Hibbertia stichodonta* Toelken, sp. nov.**

Hibbertiae vestitae similis sed dentibus serialibus inter nervos centrales et margines revolutos in foliis distalibus vel bracteis, lobis calicis interioribus pilis brevis simplicibus vel furcatis differt.

Type: New South Wales (CC), San Remo, Budgewoi, R. Grant-Newman s.n., ix.1993 (holo.: AD; iso.: NSW).

Hibbertia vestita auctt. non A. Cunn. ex Benth.: N.C.W. Beadle, Student's Fl. N.E. New South Wales 3: 256 (1976), p.p.; G.J. Harden & J. Everett in G.J. Harden, Fl. New South Wales 1: 300 (1990), p.p.; Pellow, Henwood & Carolin, Flora Sydney Region ed. 5: 126 (2009), p.p.

Shrublets up to 0.3 m tall, spreading, little branched; branches wiry becoming rigid-woody, with prominent decurrent leaf bases, pubescent to hirsute. *Vestiture* persistent, usually with very short spreading simple hairs overtopped by very much longer and often coarse hairs; *on branches* sparse with very short erect hairs overtopped by distinctly longer, often \pm antrorse hairs up to 1.8 mm long mainly restricted to the grooves along the decurrent leaf bases; *on leaves above and below* scattered, with a mixture of short to longer spreading to erect simple hairs, each usually with a flat basal pustule; *on bracts* above and below, similar to leaves but smaller and without pustules; *on outer calyx lobes* outside with few short spreading simple hairs overtopped by scattered much longer often almost erect hairs with basal tubercle concentrated along the central ridge, inside very dense short simple hairs (some forked) on the distal two-thirds; *on inner calyx lobes* outside densely covered with short erect simple hairs (few to many forked and/or fascicled) with scattered longer ones along the central ridge, inside similarly densely covered with very short erect simple hairs (some forked) on the distal half. *Leaves* with intrapetiolar tufts of hair up to 0.1–0.3 mm long and usually shorter than the long hairs on the internodes above and below; *petioles* 0.2–0.5 mm long; *lamina* linear to oblong-lanceolate, $(2.6\text{--}) 4.5\text{--}7.5$ $(\text{--}9.2) \times (0.5\text{--}) 0.7\text{--}1$ $(\text{--}1.2)$ mm, scarcely but gradually tapering into the petiole, acute to becoming rounded with pronounced reflexed end of vein, above convex and sparsely pilose, below with broad central vein recessed to rarely flush with, and tightly wedged in between, the revolute margins and frequently exposing rows of teeth, sparsely pilose. *Flowers* single, sessile, terminal mainly on main branches; *flower stalk* absent; *buds* broadly ovoid; *primary bracts* linear to linear-elliptic, $(2.2\text{--}) 3\text{--}4.5$ $(\text{--}5.3) \times (0.3\text{--}) 0.4\text{--}0.6$ mm, dorsiventrally compressed and leaf-like, with acute apex usually slightly recurved, with central vein and revolute margins though reduced touching one another and without exposing the undersurface, pilose to pubescent; additional bracts $(0\text{--}) 2$ or 3 , merging into cauline leaves. *Calyx* lobes unequal; *outer calyx lobes* broadly ovate, $(6.8\text{--}) 7\text{--}8$ $(\text{--}9.4) \times 3\text{--}3.3$ $(\text{--}3.5)$ mm, longer than inner ones, pointed to acuminate, scarcely ridged distally, outside sparsely hirsute to tomentose overtopped by scattered longer simple hairs, inside shortly pubescent on distal two-thirds; *inner calyx lobes* broadly ovate to oblong-ovate, $(6.6\text{--}) 7\text{--}7.7$ $(\text{--}8) \times (4\text{--}) 4.5\text{--}5$ (5.3) mm, rounded to emarginate, not ridged, outside tomentose with \pm strigose centre and glabrous membranous margins, inside with a finely tomentose patch on the distal third. *Petals* broadly obovate, up to 10.4 mm long, bilobed. *Stamens* 22–30 $(\text{--}40)$, without or with few staminodes, tightly surrounding the ovaries; *filaments* strap-like, 1.8–2.4 mm long, broadening basally, \pm connate; *anthers* narrowly obloid, $(1.7\text{--}) 2.4$ $(\text{--}3)$ mm long, abruptly constricted above and below. *Pistils* 3; *ovaries* obovoid, each with 4 ovules, hirsute;

styles attached to the apex of the ovaries and then spreading centrifugally with the terminal stigmas erect at or just above the level of the anthers. *Fruit* erect, shortly hirsute. *Seeds* narrowly obovoid to comma-shaped, $1.6\text{--}1.8 \times 1.1\text{--}1.3$ mm, attachment \pm lateral, dark brown; *aril* with fleshy attachment to one side surmounted by a membranous cup with short lobes to the other side covering the lower third of the seed. *Flowering*: September–November. **Fig. 3F–I.**

Distribution and ecology. Grows on low sandstone hills of the coastal foothills in sclerophyll forest in the central coastal foothills of New South Wales (NC, CC). Although not specified, the specimen *P.Sharpe* 759A from Queensland is presumably of cultivated origin.

Conservation status. Frequency unknown and not known from any conservation reserves.

Diagnostic features. *Hibbertia stichodonta* is also unusual among species of the *H. vestita* group by having usually a very dense cover of short hairs on the outside of the inner calyx lobes and some of these are forked (rarely fascicled, e.g. *Telford* 2225) from the base. It closely resembles *H. vestita*, but is distinguished by the well developed raised central vein of the leaves, which is wedged in between the revolute margins. However, because the vein is more or less recessed it might not be easy to distinguish leaves of *H. stichodonta* from rolled leaves of *H. vestita*, as the revolute margins may also be touching the central vein. The broadened flat bracts of *H. vestita* are never so strongly inrolled so as not to expose some part of the undersurface, while in *H. stichodonta* the undersurface of the bracts is not visible. Bracts and (usually) leaves with strongly inrolled margins will show rows of small teeth between the revolute margins and the central vein.

The central vein of leaves of *H. stichodonta* often also protrudes well beyond the apex. Leaves of *H. stichodonta* can be distinguished from those of *H. expansa* by an usually recurved apex, similar to that of *H. vestita*.

Variation. The central vein on the leaves is \pm raised and wherever the undersurface is exposed, both the central vein and the revolute margins are, in contrast to *H. vestita*, well defined. Although the central vein rarely becomes flush with the revolute margins, its protrusion beyond the apex is variable, but at times up to 1.4 mm long, and the tip of the vein is usually reflexed.

The outer calyx lobes are usually acute to pointed but in the type specimen they are drawn into acuminate points.

The number of fertile stamens is very variable, as is the number of staminodes. Staminode number varies from, for instance, none on the type specimen, which has about 35 fertile anthers to up to 20 fertile anthers and many staminodes on *I.R.Telford* 2225.

Etymology. The epithet “stich-odonta”, Latinised Greek, “in-rows-toothed” refers to the rows of teeth found

between the central vein and the revolute margins of bracts and leaves, which is one of the characters distinguishing this species from *H. vestita*.

Specimens examined

?QUEENSLAND: *P.Sharpe* 759A, Griffith University site, Kassels Road, Mt Gravatt, 20.ix.1973 (BRI).

NEW SOUTH WALES: *R.Bates* AD98753120A, 20 km SW Newcastle, 10.x.1987 (AD); *J.L.Boorman* NSW 85814, Morisset, x.1899 (NSW); *R.H.Cambage* 529, Newcastle, 4.x.1901 (NSW); *L.H.Johnson* NSW85815, Kanwal, 11.x.1953 (CANB, NSW); *M.E.Phillips* 493, near Wyong, 23.ix.1972 (CBG 56619); *H. Salasoo* 2393, Doyalson to Wyee, 29.ix.1962 (NSW); *I.R.Telford* 2225, Pacific Hwy - Freemans Park Track, 24.xi.1970 (CANB).

Hibbertia vestita A.Cunn. ex Benth.

Fl. Austral. 1: 31 (1863); F.Muell., Syst. Cens. 1: 2 (1882); F.M.Bailey, Syn. Queensland Fl.: 4 (1883); C.Moore, Cens. Pl. New South Wales: 1 (1884); F.Muell., Second Syst. Cens. 1: 2 (1889); Gilg, Nat. Pflanzenfam.III(6): 117 (1893); C.Moore & Betche, Handb. Fl. New South Wales: 10 (1893); F.M.Bailey, Queensland Fl. 1: 14 (1899); F.M.Bailey, Compr. Catal. Queensland Pl.: 13 (1913); Domin, Biblioth. Bot. 89: 422 [976] (1928); N.C.W.Beadle, Student's Fl. N.E. New South Wales 3: 255, Fig. 17E (1976), p. p.; Stanley in Stanley & E.M.Ross, Fl. S.E. Queensland 1: 187 (1982); G.J.Harden & J.Everett in G.J.Harden, Fl. New South Wales 1: 300 (1990), p.p.; Jessup in Bostock & A.E.Holland, Cens. Queensland Fl. 63/64 (2007); Pellow, Henwood & Carolin, Flora Sydney Region ed. 5: 126 (2009), p.p. — **Type:** Queensland, near Moreton Bay, *A.Cunningham* s.n., ix.1824 (lecto.: — **here selected** — K*; presumed iso.: K-partly, BM 2 \times , MEL35991; syn.: *Beckler* s.n., Clarence River (MEL35986*, MEL35987, MEL35988*, NSW85797); *A.Cunningham* 53, Moreton Bay (K, MEL35989); *Fraser* 93* & *Frazer* 94*, Stradbroke Island (K); *Fraser*, Moreton Bay, 1828, (BM); *F.Mueller**, Glasshouse Mountains, 1837 (K); *Leichhardt**, swamps towards Duval (MEL35992, NSW121134) — see typification; an asterisk (*) indicates that Bentham signed the specimen.

Shrublets up 0.3 m tall, multi-stemmed from a rootstock, moderately to much branched, spreading to prostrate; branches wiry becoming rigid at the base, hirsute to pilose. *Vestiture* persistent, with usually a range of shorter to longer spreading simple hairs; *on branches* dense to sparse, with short porrect simple hairs overtopped by longer erect ones up to 1.2 mm long; *on leaves above and below* excluding the glabrous undersurface, sparse to scattered, with scarcely longer and shorter antrorse spreading simple hairs with flat often not distinct basal pustules becoming denser proximally particularly adaxially, end of central vein with usually very short tuft of hairs to glabrescent; *on bracts* similar but usually sparser than leaves (without pustules) and sometimes with few short hairs on the undersurface; *on outer calyx lobes* outside sparse to dense with usually few short spreading simple hairs, particularly proximally, overtopped by longer coarse mainly proximally and along the margins, often sparser between distal ridge and revolute margins, inside with mainly long coarse antrorse-appressed simple hairs on

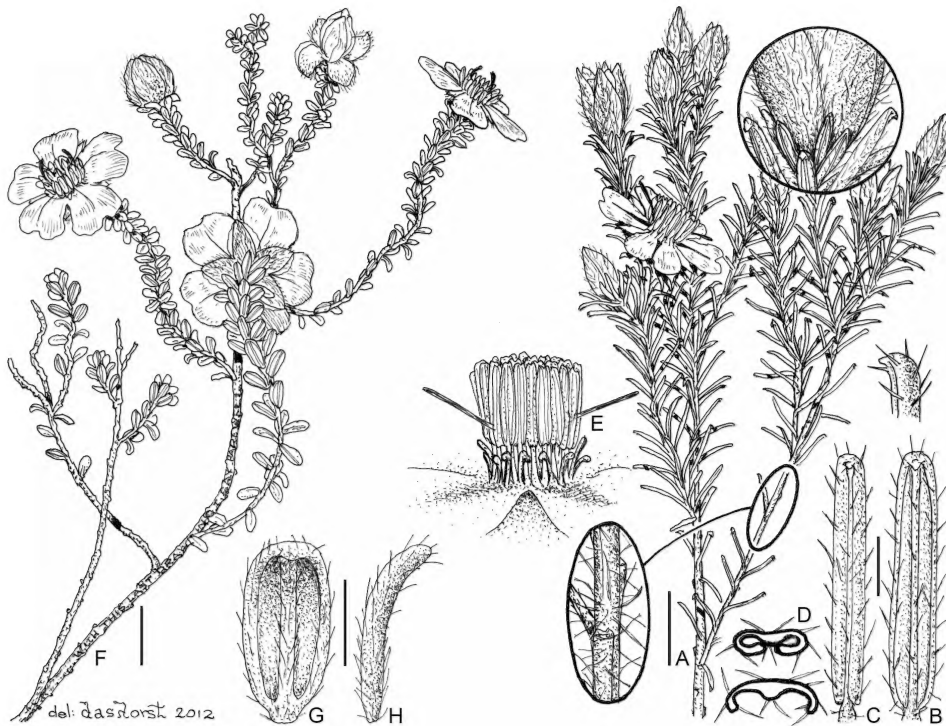


Fig. 4. A–E *H. vestita* var. *vestita*: A flowering branch; B abaxial view of leaf, flattened to expose the undersurface; C abaxial view of rolled leaf with undersurface not visible; D transverse section (mid-leaf) of revolute and flat leaf; E androecium with many staminodes. F–H *H. vestita* var. *thymifolia*: F flowering branch; G abaxial view of leaf; H side view of leaf. — Scale bars: A, F 10 mm; B, C, G, H 2 mm. — A–E F.M. Isaac 1095, F.C.L. Wilson 574, G, H E.F. Constable 6383.

distal half to third; on inner calyx lobes outside usually dense, with mainly longer antrorse, \pm appressed coarse simple hairs becoming shorter towards the glabrous membranous margins, inside with few very short appressed simple hairs aggregated in a patch below the apex. Leaves with intrapetiolar tuft of hairs often sparse, up to 0.6 mm long; petioles 0.2–0.6 mm long; lamina linear, linear-lanceolate, rarely oblong or ovate-oblong to almost orbicular, $(2.1\text{--}3.5\text{--}8\text{--}(11.4) \times (0.5\text{--}) 0.6\text{--}1\text{--}(3.4)$ mm, abruptly tapering into petiole or cordate, but often obscured on rolled leaves, acute or rounded with very short terminal mucro or end of central vein reflexed with short tuft of hairs or glabrescent, above convex or rarely with a slight depression along the central vein and pilose, puberulous or glabrescent, below with narrow central vein slightly more raised proximally, but rarely to the level of the revolute margins and then rarely touching midvein when leaves are rolled, both pilose to glabrescent, but exposed undersurface between them glabrous. Flowers single, sessile or subsessile, terminal on main and lateral branches or occasionally on short shoots below a terminal flower; flower stalk 0–4 mm long; buds ovoid; primary bracts oblong-elliptic, $(1.6\text{--}2.5\text{--}4\text{--}(5.2) \times (0.7\text{--}) 1\text{--}1.4\text{--}(1.6)$ mm, acute, flat and

leaf-like, with apex usually recurved, with central vein and revolute margins scarcely developed, pilose; additional bracts 3 or 4, of varying shapes and often not merging into cauline leaves. Calyx lobes unequal; outer calyx lobes lanceolate to ovate, $(5.2\text{--}) 6\text{--}8\text{--}(9.8) \times (2.8\text{--}) 3\text{--}4.5\text{--}(5.6)$ mm, usually longer than inner ones, acute, with distinct central ridge and often slightly recurved distal margins, outside hirsute to strigose, inside strigose to pubescent on distal half; inner calyx lobes obovate to oblong-obovate, $(5.4\text{--}) 5.8\text{--}7.5\text{--}(8.4) \times (3.6\text{--}) 3.8\text{--}4.5\text{--}(6.6)$ mm, obtuse to rounded or sometimes emarginate, without central ridge, outside dense but finer strigose, inside glabrous or with subterminal hairs. Petals broadly obovate, up to 12.5 mm long, usually bilobed. Stamens 22–43 and staminodes numerous, rarely few, surrounding the ovaries; filaments strap-like or rarely filiform above becoming broader and often connate towards the base, 0.8–2.2 mm long; anthers narrowly obloid, 1.2–2.6 mm long, scarcely tapering into filaments below, abruptly constricted above. Pistils 3; ovaries obovoid, each with 4–6 ovules, hirsute rarely pubescent; style attached to the apex of ovaries then curved outwards and spreading centrifugally, with stigmas borne at level with but distant from anthers. Fruit erect, hirsute with simple

hairs. *Seeds* obovoid to comma-shaped, $2\text{--}2.2 \times 1.5\text{--}1.8$ mm, dark brown to black; aril attachment \pm lateral and fleshy but extended into a slightly lobed membranous cup reaching the apex of the seeds on one side and only about half of the other side.

Diagnostic features. The most obvious character of *H. vestita* is the usually scarcely raised central vein, which is only slightly broadened at the base of the lamina. The undersurface is usually more or less visible, unless the leaves are tightly rolled, but it can still be distinguished from similar species (e.g. *H. expansa*, *H. mediterranea* and *H. stichodonta*) by leaves with broad central vein, the absence of teeth between the vein and the revolute leaf margins, and by bracts below the flowers, which are never fully in-rolled. Specimens of *H. porcata* with sessile/subsessile flowers from the Central and Southern Tableland of New South Wales are often referred to *H. vestita*, but are usually recognizable by their broader central vein, which is more or less wedged-in between the revolute leaf margins.

Hibbertia serpyllifolia has a similar, or in some cases less well developed, central leaf vein, but is distinguished by its smaller flowers with fewer stamens, more or less arranged in groups around the ovaries, thread-like filaments and the absence of staminodes. The bracts of *H. vestita* var. *vestita*, which are more or less petiolate and/or flattened, are long, c. half to as long as the calyx, and usually appressed to the flowers, while in *H. serpyllifolia* at least the primary bracts are more or less spatulate with a short lamina, usually less than a third of the length of the calyx and spreading to recurved. They are also recurved in *H. vestita* var. *thymifolia*.

Some specimens of *H. humifusa* with short-stalked flowers resemble *H. vestita* superficially, but are easily distinguished by many multiangular fascicled hairs on most parts and stamens only on one side of the ovary.

Typification. Bentham (1863) refers to five collections by Beckler, Cunningham, Fraser, Leichhardt and Mueller and at least one of each of them is annotated by him (cf. type citation). All the cited specimens represent *H. vestita*, but, as Bentham quotes the species as being based on a name from the Cunningham herbarium, preference is given to the Cunningham collections. The specimen labelled "Moreton Bay, Sept. 1824" in K is also accompanied by a short description of the plant by the collector. Accordingly, the lower central branch with a flower on that sheet is here selected as the lectotype. This sheet and three others in K were annotated by Bentham in red pencil as "Hibb. vestita A.C." Among them there are two specimens, *Fraser 93* and *Fraser 94*, both from Stradbroke Island, and one by *F. Mueller*, from the Glasshouse Mountains. The sheet of *Fraser 93* includes a specimen of *A. Cunningham 53*, but without date or locality. Since Cunningham visited the Moreton Bay with Fraser in 1828 (Curry et al. 2002) one might assume it to be a later collection. A sheet of *A. Cunningham 53* (MEL35989) is, however, inscribed

"Moreton Bay, 1824" on the collector's label. Both these collections of Cunningham's no 53 are treated here as syntypes, similar to the two Fraser specimens, which are both from the same expedition. Two Cunningham collections at BM, from "Moreton Bay, 1825" are treated as possible isoelectotypes, as the date probably reflects when the specimens were deposited in that herbarium and do not represent a later collection. No specimens by Cunningham of this species from his later expeditions to the area in 1828 and 1829 (Curry et al. 2002) are known.

Hibbertia vestita var. *vestita*.

Benth., Fl. Austral. 1: 31 (1863).

Hibbertia vestita var. *genuina* Domin, Biblioth. Bot. 89: 423 [1977] (1928), *nom. inval.*

Shrublets decumbent, spreading, with wiry branches straight and erect-spreading ends. *Leaves* linear to rarely oblong, (2.2–) 3.5–8 (–11.4) \times (0.5–) 0.6–1 (–1.4) mm, straight or apex only slightly recurved, with varying long and short antrorse hairs persistent or often wearing off, with broad pustules rarely raised. *Flowering*: Mainly September–December, but also some records throughout the year. **Fig. 4A–D.**

Distribution and ecology. Grows in sandy soil on coastal dunes, often associated with rock outcrops of various substrates (e.g. sandstone, rhyolite, shale), in coastal heath or shrub vegetation in open woodland in the foothills east of the Great Divide in south-eastern Queensland (WB, MO) and north-eastern New South Wales (NC). Records of the species from "coast north of Botany Bay" (Pellow et al. 2009) probably refer to specimens of *H. stichodonta*.

Conservation status. Not considered at risk. Widespread and locally common.

Variation. The shape of the leaves largely depends on the degree of rolling of the leaf margins, presumably under adverse conditions. This might obscure the identity of the species, which is usually easily recognised by its narrow recessed central vein exposing the leaf undersurface on both sides. It is therefore useful to examine also the flat bracts (including additional bracts), which, in contrast to those of the very similar *H. stichodonta*, clearly exhibit the narrow central vein and exposed undersurfaces. However, *C. Burgess CBG28111* from Barcoongere State Forest has very fleshy leaves with a somewhat broader central vein and rigid-woody stems. Viewed on its own this might seem significantly different, but compared to a range found in other specimens from northern New South Wales (e.g. *R.D. Hoogland 11787*) shows that this is merely an extreme form.

The size of the leaves also varies considerably from well into the range of var. *thymifolia* to twice that size on, for instance, *H.M.R. Rupp NSW85826* and *R.D. Hoogland 11787*, but these specimens have straight branches and leaves. Other plants have slightly curved or twisted branches (e.g. *M. Harris NE13988A*), and are reminiscent to but distinguished from var. *thymifolia* by

their leaves and bracts not being alike or recurved (cf. Fig. 4G, H). Although leaves are usually not densely hairy, they are also rarely almost glabrous as in *B. Lebler* & *P. Baxter* BRI84991A.

Selection of specimens examined (c. 170 seen)

QUEENSLAND: *L.G. Adams* 3478, Wide Bay Military Training Area, 16.ix.1980 (BRI, CANB, NSW); *E.W. Bick* BRI10906, Redcliffe, x.1911 (BRI); *S.T. Blake* 2676, Petrie, 18 miles [28.8 km] N Brisbane, ix.1931 (BRI, K); *S.T. Blake* 3042, Lawnton, 17 miles [28.2 km] N Brisbane, 18.xii.1931 (BRI); *N.T. Burbidge* 3636, Stradbroke Island, 27.v.1951 (CANB); *H. Dillewaard* 89 & *M. Olson*, Beerwah State Forest, 26.ix.1980 (BRI); *D.A. Goy* 44, Stradbroke Island, near Brown Lake, 1.ix.1935 (BRI); *D.A. Goy* BRI10890, Cruickneck, Glasshouse Mts, 24.v.1935 (BRI); *D.A. Goy* BRI10912, Lookout Point, Stradbroke Island, 21.iv.1935 (BRI); *C.E. Hubbard* 3416, between Palmswood and Landsborough, 21.vii.1930 (BRI, K); *C.E. Hubbard* 3694, Oxenford, S Brisbane, 17.viii.1930 (BRI); *C.E. Hubbard* 3780, hills near Plunkett, 31.viii.1930 (BRI, K); *C.E. Hubbard* 4331, Broadwater near Brisbane, 5.x.1930 (BRI); *F.H. Kenny* BRI10888, Caloundra, viii.1908 (BRI); *B. Lebler* & *Baxter s.n.*, Sunshine Beach near Noosa Heads, 21.v.1968 (BRI); *W.J. McDonald* BRI375462, Toorbul Point, 13.xi.1975 (BRI); *N. Michael* BRI 10909, Woodridge, 17.ix.1931 (BRI); *P.R. Sharpe* 759B, Griffith University site, Kassels Road, Mt Gravatt, 20.ix.1973 (BRI); *P.R. Sharpe* 1279, 2 km N Coolumb Beach, 8.ix.1975 (BRI); *P.R. Sharpe* 2994, Mt Coolumb, 17.ix.1981 (BRI); *P.R. Sharpe* 3001 & *G. Batianoff*, Mt Coolumb, 18.ix.1981 (BRI); *A.V. Slee* 3417 & *B.J. Lepschi*, Mt Beerwah, 21.x.1993 (CANB); *T. Stanley* 32 & *J. Clarkson*, Saddleback Mt in Glasshouse Mountains 7.ix.1974 (BRI); *C.T. White* 6162, Rochedale Road near Brisbane, 24.viii.1929 (BRI); *C.T. White* 6709, Amity Point, Stradbroke Island, 18.iv.1930 (BRI); *C.T. White* 9199, Southport, 1.ix.1933 (BRI); *C.T. White* BRI10891, Candle Mt, v.1918 (BRI); *C.L. Wilson* 688, slopes of Mt Gun Gun, 29.v.1957 (BRI).

NEW SOUTH WALES: *B. Auld* 120474, Angourie Bay, 5.x.1984 (NSW); *R. Bates* 12849, Yuragin National Park, 23.xi.1987 (AD); *R. Bates* 12877, Coffs Harbour Airport, 23.xi.1987 (AD); *R. Bates s.n.*, Myall Lakes, x.1987 (AD); *J.L. Boorman s.n.*, Port Stephens, ix.1911 (AD, BRI, NSW); *C. Burgess* 219, Moonee, 23.viii.1973 (CANB, NSW); *C. Burgess* CBG18325B, Coffs Harbour, 26.x.1966 (CANB, MEL119831); *J.B. Cleland* AD98142014, Byron Bay, 30.ix.1912 (AD); *B.J. Conn* 3477, Jerusalem Creek Track, Bundjalong National Park, 20.ii.1990 (AD, NSW); *E.F. Constable* NSW41749, c. 6 miles [9.6 km] N Corindi, 2.xi.1956 (NSW); *L.M. Copeland* 1779, Candole Forest, – Minnie Waters roads junction, 1999 (NSW); *M. Harris* NE13988a, Sawtell, iii.1958 (NE); *P. Hinds* 3094, Woolgoolga headland, 31.iii.1982 (NSW); *R.D. Hoogland* 11787, along Macauley Lead, c. 10 miles [16 km] SSW Evans Head, 11.x.1970 (BRI, CANB, MEL, NSW); *L.A.S. Johnson* NSW85816, 2 miles [3.2 km] W Karuah, 12.x.1953 (CANB, NSW); *R. Johnstone* 2451 & *A.E. Orme*, 0.3 km S Arthurs Gap, 24.xi.2008 (NSW); *B. Lebler* BRI63034, Yamba Point on Clarence River Mouth, 23.viii.1966 (BRI); *J.H. Maiden* & *J.L. Boorman* NSW85803, Coffs Harbour to Grafton, xi.1903 (NSW); *D.J. McGillivray* 2090, 4 miles [6.4 km] S Yamba, 30.vi.1966 (NSW); *A. Meebold* 3494, Coffs Harbour, iii.1929 (AD); *A. Richards* CBG17870, 5.4 miles [8.6 km] E Ebor on Ebor-Grafton road, 15.vii.1966 (CANB); *H.M.R. Rupp* MEL35985, Copmanshurst, x.1911 (MEL); *H.M.R. Rupp* NSW85826, Byron Bay, 12.viii.1915 (NSW); *K. Thurtell* & *R. Coveny* 3837, 21.6 km N Macksville, 8.xii.1971 (CANB); *H.R. Toelken* 7999, 0.5 km N turnoff to Kingala, on

Glenreagh–Grafton road, 23.x.1989 (AD, NSW); *H.R. Toelken* 8476, S. Red Rock, 9.xi.1993 (AD, NSW, BRI).

Hibbertia vestita var. *thymifolia* Benth.

Fl. Austral. 1: 32 (1863); F. Muell., Syst. Cens. 1: 2 (1882); F.M. Bailey, Syn. Queensland Fl.: 4 (1883); C. Moore, Cens. Pl. New South Wales: 1 (1884); F. Muell., Second Syst. Cens. 1: 2 (1889); Gilg, Nat. Pflanzenfam. III(6): 117 (1893); C. Moore & Betche, Handb. Fl. New South Wales: 10 (1893); F.M. Bailey, Queensland Fl. 1: 14 (1899); F.M. Bailey, Compr. Catal. Queensland Pl.: 13 (1913); Domin, Biblioth. Bot. 89: 422 [976] (1928). — **Type:** Queensland, near Moreton Bay, *A. Cunningham s.n.*, s.d. (holo.: K; iso.: BM, MEL).

Hibbertia vestita auct. non A. Cunn. ex Benth.: N.C.W. Beadle, Student's Fl. N.E. New South Wales 3: 256 (1976), p.p.; Stanley in Stanley & E.M. Ross, Fl. S.E. Queensland 1: 187 (1982), p.p.; G.J. Harden & J. Everett in G.J. Harden, Fl. New South Wales 1: 300 (1990), p.p.

Shrublets prostrate, with wiry branches ± bent or twisted, mat-forming. Leaves oval to almost orbiculate, (2–) 3–4.5 (–5.2) × (1.2–) 2.2–3 (–3.4) mm, ± recurved lengthwise, with uniformly short, persistent antrorse-spreading hairs each with small pustules. Flowering: mainly October–December but also into April. **Fig. 4F–H.**

Distribution and ecology. Growing in exposed, often windshorn grassland on headlands with *Themeda triandra*, *Banksia integrifolia*, *Acacia longifolia* subsp. *sophorae*, *Zieria prostrata* and *Hibbertia vestita* (*R. Johnstone* 2161 & *A.E. Orme*), rare in southern Queensland (WB, MO) and northern New South Wales (NC).

Conservation status. “Locally abundant” in Moonee Beach State Conservation Area (*R. Johnstone* 2161 & *A.E. Orme*), but no recent specimens from Queensland have been seen.

Diagnostic features. *Hibbertia vestita* var. *thymifolia* is distinguished from the very similar var. *vestita*, with which it often grows sympatrically (e.g. *C. Burgess* CBG18325A & B), by a prostrate and usually mat-forming habit with most branches twisted or curved (not ± straight as in var. *vestita*), the leaf lamina being only (1–) 2–3.5 times longer than broad and recurved for the whole length (straight and reflexed at petiole in var. *vestita*), and by a recurved and leaf-like primary bract not clasping the flowers. Other characteristics by which *H. vestita* var. *thymifolia* differs, but which sometimes show some overlap with those of var. *vestita*, include hairs on the proximal adaxial leaf surface that are denser just above the petiole, cauline leaves with the margin never strongly revolute, so that the undersurface is always at least partly visible (commonly strongly revolute in var. *vestita*), the outer calyx lobes about as long as the inner ones, and usually rounded or rarely obtuse (usually outermost longer and acute to acuminate in var. *vestita*).

Variation. Plants recorded from northern New South Wales (e.g. *J.L.Boorman NSW85819*, *F.Robbins sub A.C.Beauglehole 8672*) have even narrower leaves and the outermost calyx lobes longer than the inner ones similar to those of var. *vestita*, but as the branches are twisted and leaves and bracts are recurved they are included in var. *thymifolia*.

Several sheets of the mixed collection (*C.Burgess CBG18325A* & B) show always two distinct varieties, so that the characteristics of *H. vestita* var. *thymifolia* seem to be neither determined by its habitat nor are the two varieties separated by different habits. Significant in this respect is that a collection from a garden near Toowoomba (*L.A.Boyce 2*) far away from sea spray on coastal headlands, still retained its broad recurved leaves. The specimen also still displays twisted branches, although the plant is described as small shrub 12–15 cm high and 20–40 cm across and not mat-forming, as is often recorded for coastal plants.

Leaves vary greatly in width and in density of the vestiture—as, for instance *K.Grieves NSW85817* is practically glabrous except for intrapetiolar tufts of hair. Although the leaves of *H. vestita* var. *thymifolia* are generally broader than those of the typical variety, some overlap in this character has been observed. Some leaves, for instance *B.Lebler BRI63034* (Clarence River Mouth), may display a degree of recurvature, but the laminae and branches are generally straight in this taxon. Erect bracts, which more or less clasp the flowers are another important distinguishing feature of this taxon.

Despite considerable morphological similarities and a marginally overlapping range of most of the distinguishing characters, all specimens examined could be placed in either variety. Although the varieties seem to occur sympatrically no convincing evidence of hybridization between the two has been observed.

The occurrence of var. *thymifolia* in Queensland has not been confirmed by recent collections. *R.Bates 16586*, collected from near Stanthorpe represents a disjunct locality from an unlikely (non-coastal) habitat for this species.

Specimens examined

QUEENSLAND: *R.Bates 16586*, ?Stanthorpe, 31.xii.1988 (AD); *L.A.Boyce 2*, 6 Range Street, Toowoomba, 9.xi.1979 (BRI cult.); *R.L.Higgins BRI11150*, Noosa, iii.1919 (BRI).

NEW SOUTH WALES: *R.Bates 12840*, Coffs Harbour headlands, 23.xi.1987 (AD); *D.F.Blaxell 144*, Bare Point, N Woolie, 8.ii.1969 (NSW); *J.L.Boorman NSW85819*, Coffs Harbour, v.1909 (NSW); *J.L.Boorman NSW85820*, Coffs Harbour, vi.1911 (NSW); *C.Burgess CBG18325A*, Coffs Harbour, 26.x.1966 (CANB, MEL119831); *E.F.Constable 6382*, Green Bluff, Woolgoolga, 20.xi.1965 (K, NSW); *R.Crawford CBG43390*, 0.8 km N Coffs Harbour, i.1969 (CANB); *K.Grieves NSW85817*, Diamond Head, S Woolgoolga, 26.ii.1967 (NSW); *R.Johnstone 2161* & *A.E.Orme*, Moonee Beach State Conservation Area, 5.xi.2007 (NSW); *M.Kennedy 636* & *B.Rann*, Dammerels Head, S Emerald Bay, 17.x.1993 (NSW); *F.Robbins sub A.C.Beauglehole 8672*, Angourie Point near Yamba, 1945 (MEL); *T. & J.Whaite 3463*, S.Woolgoolga, 9.i.1971 (NSW);

C.L.Wilson 574, 4 miles (6.4 km) N Woolgoolga, 15.iv.1957 (BRI, NSW).

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An ABR Capacity Grant enabled me to visit BRI, CANB, MEL and NSW in 2011/12 to examine and add the most recent records including two more species into this revision. I acknowledge the hospitality while visiting and/or the loan of a great number of specimens from BM, BRI, CANB, HO, G, JCU, K, MEL, NSW, NE, and QRS.

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David Eric Symon (1920–2011)

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Introduction

This is a review of the taxonomic work with which David Symon was associated during his working life at the Waite Institute, University of Adelaide (1950–1985) and, following his retirement from there, as an Honorary Research Associate of the State Herbarium of South Australia (1985–2011). It is a means of documenting his scientific publications and his plant collections held by the State Herbarium, and also a means of recording some of his other activities involving plants and fledgling societies. Further background to David can be found in articles produced on the Waite Arboretum and Herbarium (Gardner 1990), on the occasion of the awarding of his D.Sc. (Barker 1997), the awarding of life membership to the Australian Systematic Botany Society (Barker 2000) and at the time of his death (Anon. 2012, Barker 2012a, Barker 2012b, Gardner 2012).

David came to Australia at an early age in 1922 and until 1935, when they moved to Adelaide, his family farmed at Pyap, near Loxton (Symon 1991). Following early employment at Lasscock's nursery and with the South Australian Railways, David was able to complete the Roseworthy Agriculture diploma with distinction and then continue on to an Honours Agricultural Science degree, graduating in 1951. From then on his working life was entirely within the Agronomy Department of the Waite Agricultural Research Institute (1924–1991)¹, firstly as Lecturer in Agronomy, followed by his appointment in 1956 as the Systematic Botanist and then in 1962 as Senior Lecturer in Botany. By the time of his retirement in 1985 he had achieved the status of Reader in the Department. During this time David was responsible for the Herbarium (ADW) and the Arboretum as well as for lecturing to undergraduate Agricultural Science students. Part of his course involved a 3–5 day bus trip for third year students to various agricultural areas of the State.

David did not receive formal training in the practices of taxonomy. However his association with his

predecessors at the Waite Institute, Constance Eardley and Enid Robertson, and with the newly-arrived (1955) and European-trained Hansjoerg Eichler at the State Herbarium of South Australia (AD), his need to run the newly invigorated herbarium at the Waite, his giving of the lectures to Agricultural Science students, the running of the Arboretum and study leave at the herbarium in Kew Gardens in 1963 would all have contributed to his development in this area. He was also exposed to the thoughts of other Australian botanists through his membership of committees formed to establish a new *Flora of Australia* (see below). On the retirement of Miss Eardley from the Botany Department in 1971, David gave the traditional taxonomy lectures to second-year Botany students for the next couple of years, before the appointment of David Christophel; these lectures were very well received by the students.

David retired from the Waite at the end of 1985 and from that time worked in retirement at the State Herbarium of South Australia, whilst still retaining close contact with the Arboretum and his part-time successor there, Jennifer Gardner. Both institutions took up most of the working week although he usually found some time to engage in non-botanical activities for at least part of one day of the week.

Main plant interests

The list is long and you really only need to peruse his publications to see that David had a broad interest and knowledge of the “higher” plants, and not just of their taxonomy, but of how they related to the world around them. Nor did he confine his interests to Australian plants, but through his work in the Agronomy Department and the Arboretum he also encompassed exotic plants, particularly trees, grasses and weeds.

Solanaceae

He was probably best known for his work in the Australian and New Guinea Solanaceae and his accounts for both regions have provided a base line study from which further work has been extended. It is not clear just when he began his studies in the family, but it was probably in the early 1960s and with all of its plants of economic importance it seems an obvious one for an employee in an agronomy department. In the early days of his studies of *Solanum*, while still employed at the Waite and with limited collections to examine, he was in

¹ The Waite Agricultural Research Institute was established in 1924 following a bequest to the University of Adelaide by Peter Waite. It was generally known by that name until 1991, when it and Roseworthy Agricultural College were amalgamated to become part of the University of Adelaide's new Faculty of Agricultural and Natural Resource Sciences. Now, the Waite campus is home to the Waite Research Institute, with the Waite Arboretum still occupying the same land adjacent to the Urrbrae House Historic Precinct.

the habit of growing plants in pots from seed, either in the Waite gardens or in his own home garden, and making observations on flowers and fruits which had, until that time, been unknown. These plants would then be made into herbarium specimens. In 1963 he spent his study leave working in the herbarium at Kew Gardens and then in 1970 his study leave was spent at the University of Birmingham with Professor J.G. Hawkes, the noted crop plant geneticist specialising in potatoes, and Richard Lester, chemotaxonomist and Solanaceae expert (see *International Solanaceae Conferences*, below).

His interest in *Solanum* predated the visit of Russian botanists to collect seed of kangaroo apples in 1968; kangaroo apples had previously been identified as a superior source of the alkaloid solasodine, and the Russians did establish a short-lived industry, but Australian attempts were less successful. Although he appears never to have published it, David did give a paper to the ANZAAS conference in Perth in 1973 on the domestication of *Solanum laciniatum* and he retained a strong interest in the kangaroo apples, culminating in his own account of their taxonomy and history prepared in time for the International Solanaceae Conference he hosted in Adelaide in September 1994 (Symon 1994). He provided identifications of *Solanum* for chemist David Collins of Monash University in the 1970s and these were part of multiple authored papers on a survey of *Solanum* for potentially useful sources of solasodine (Bradley et al. 1978, Bradley et al. 1979). This all arose out of the ill-fated attempt to establish a steroid pharmaceutical industry in South Australia in 1976; David's role in this enterprise was as provider of seed and seedlings for planting (Symon 1994), as well as botanical expert in the genus. He also participated in a 5 week field trip to remote areas of Western Australia and the Northern Territory with David Collins and Frank Eastwood of Monash University in May–June 1975. The purpose of this trip² was to collect specimens of those *Solanum* species not yet represented in the alkaloid survey, but it also allowed David to see a number of new species. David remained interested in *Solanum* in general up until his death and was supplying Dr Kerry Wilkinson of the Waite with kangaroo apple fruits for analysis (see below).

David's *magnum opus* on Australian *Solanum* species was published in 1981, preceded, in the same year, by an account of the naturalised species of Solanaceae in Australia. These publications were crucial for the first familial treatment published the next year in the new *Flora of Australia* series (Purdie et al., 1982). Rosemary Purdie wrote most of the text, based on the work of David and two ABRs graduates under his supervision, Laurie Haegi (*Datura*) and Philippa Horton (*Nicotiana*).

² David Collins has put together an account of this trip, funded by a grant from the Rural Credits Development Fund of the Reserve Bank of Australia, based on the trip diary kept at the time. It contains maps and images as well as an informative text and should there be questions concerning collecting localities it would be worth consulting (Collins 2013).

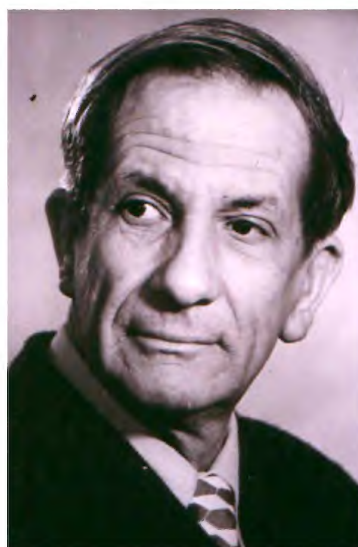


Fig. 1. David E. Symon in 1971. — Photo: Symon family.

In the year of his retirement David produced an account of the Solanaceae of New Guinea (Symon 1985). This followed on from two field trips to that country, one in 1977, when he used his study leave from the University of Adelaide to fund a trip in May–June, and used the Lae Herbarium as a base. He returned there again in May–June 1984, this time having received a grant from the Waite Agricultural Research Institute research fund.

David always felt that his account of the Australian *Solanum* species, particularly those from northern and eastern Australia, was provisional, based as it was on limited collections and field observations, and he was happy to see that his own work had promoted much further work in the genus. He continued to describe occasional species as they came to his attention (Symon & Swarbrick 1986, 1995, 2000, Brennan et al. 2006) and his opinion was widely sought. The dioecious Australian *Solanums* were of particular interest leading to additional and ongoing research by scientists from Australia and from overseas (Symon 1970, Anderson & Symon 1989, Martine & Anderson 2007, Martine et al., 2009, Barrett 2013) and it is safe to say that the taxonomy of this group is still in need of clarification. Tony Bean's series of papers predominantly on the north-eastern species (Bean 2001, 2002, 2004, 2010 & 2011, Bean & Albrecht 2008) and now the western species (Bean 2013), has added considerably to David's basic framework with the recognition of almost 60 new species, albeit with a rather narrower species concept than that of David, and a rearrangement of the species groupings. The Lucid key for Australian Solanaceae (Barker 2010), for which David provided input, projected these differing views, but it is quite clear that there is still plenty to do in the genus

within Australia. A further area of interest for David was the taxonomy and ecology of the group surrounding the bush tomato (*Solanum centrale*) as it was investigated further for commercial purposes (Collins 2002, Dennett 2006, both unpublished theses; Waycott et al. 2011); David provided advice to the authors of the two theses.

The same can be said of *Nicotiana*, a genus with which David remained biogeographically fascinated. He published some new species (Symon 1984, Clarkson & Symon 1991, Symon & Kenneally 1994, Symon 1998), altered the status of one (Symon & Lepschi 2007) and left us with at least one undescribed species and the possible resurrection of a name from the past. Whenever a new analysis was published, he could be found trying to relate his own knowledge of the genus to the results which had been published. He was further interested in the group because of its cultural significance for many indigenous peoples (Symon 2005) — a statement that was also true for the other members of the Solanaceae of cultural significance, such as *Duboisia*, *Datura* and *Brugmansia*.

The rest of the family in Australia consists largely of introduced genera, which David covered in his 1981 publication, and the Australian tribe Anthocercideae. While he had an interest in the latter group it was the subject of Laurie Haegi's Ph.D. thesis and he regarded the taxonomy of that group as "belonging" to Laurie and did not usually venture into the area except for identification and cultural interests. He would be very happy to know that Laurie is picking up on this group again in retirement. Their assertion that *Datura* was a new world genus (Symon & Haegi 1991) was somewhat controversial when it was first published although it now seems to have achieved general acceptance. It is a pity that it has only just been noticed now, but David would have been amused to see that this particular paper is still receiving mention and the context. It was referred to in a challenge to a suggestion by the director of Sotheby's Institute that the hallucinogenic *Datura stramonium* is represented in Botticelli's c. 1485 painting entitled *Venus and Mars* (Bellingham 2010). In disputing this identification art historian researcher, Hasan Niyazi (2010), said

The Thorn apple, *Datura stramonium* did not exist in Italy in Botticelli's Time. Symon and Haegi performed the definitive research on this.

David would have been even more amused and intrigued that Niyazi was convinced that it was not *Datura* that was depicted but a squirting cucumber!

It is not totally clear just which overseas herbaria David visited to study Solanaceae material, apart from Kew, and possibly Edinburgh (1963), Missouri (1982) and Bogota (1988) but he did visit and work in the Paris herbarium after the inaugural Flora Malesiana conference in honour of van Steenis in Leiden in August 1989 (Symon 1989). He and his wife Judy and her sister Mary Marlowe rented an apartment in Paris for about 6 weeks and there he worked at the herbarium for 3 days a week (pers. comm., J. Symon, Feb. 2013). While there he also



Fig. 2. David explaining herbarium collections to Robert Hill, then Senator for South Australia and Federal Minister for the Environment and Heritage, during his 2001 visit to the State Herbarium of South Australia, where he announced funding for data-capture for AVH. — Photo W.R. Barker.

visited the herbarium in Geneva. In 1997 he and Judy visited Turkey and Russia and while in Russia he visited the herbaria in St Petersburg [Leningrad] (25 Sep.) and Moscow (26 Sep.), where he met up with and was hosted by two of the botanists who had attended the Adelaide Solanaceae conference, M.V. Kirtsova and E.I. Korneva.

Pasture plant introductions

Following his 1951 Honours thesis work on the autecology and ecotypic variability of *Medicago tribuloides*, David continued work related to medics and clovers and their introduction and establishment in South Australian pastures. An extended trip by him to the Mediterranean in 1956 resulted in the collection of seeds of further cereals, pasture grasses and clovers, all to be grown and tested under South Australian conditions. He published a brief paper on the introduction of subterranean clover by A.W. Howard (Symon 1961), as well as a bibliography (Symon 1961), but considered that the story of its development and promotion by the Howard family and then the later development of other clover species remained to be documented. He was keen that someone should take this up as a project and his papers on the topic are now held by Geoffrey Bishop, but Geoffrey (pers. comm., 28 Jan. 2013) considers that it would be a "big job to pull it all together".

Cassia, later Senna

David's earliest taxonomic work was on the genus *Cassia*, later to become *Senna*. On his first extended field trip in 1953 (see below), David recognised that *Cassia* was forming hybrid swarms in the Alice Springs area (Symon 1955) and he later published a note in *Nature* on polyembryony in the genus (Symon 1956). He produced a revision of the genus in Australia in 1966 and then because of the known complexities, suggested it as a Ph.D. topic for genetics student Barbara Randell.

Rosaceae

But it was to be blackberry (*Rubus*) for which he found a new interest in the late 1990s. In attending a blackberry workshop in Victoria he was struck by the tale of differing reactions to herbicides and set out to look at the variation encompassed under the term ‘blackberry’ in Australia. In so doing he joined forces with Kathy Evans, then of the Waite Institute, with David responsible for the collecting and naming of the blackberry specimens and Kathy for analysing their DNA content. In establishing the correct name to be used for each of the Australian species he collected widely and sent material to experts in Germany, England and America — a technique somewhat different from the usual study of types, but required for this apomictic group with literally hundreds of names in Europe.

Although the taxa had already been worked out and been applied for some time the official culmination of the study was the publication of the systematics of introduced *Rubus* (Evans et al. 2007) for Australia. The earlier published, user friendly Lucid key on CD-ROM (Barker & Barker 2005), developed so that the community might attempt identification of blackberry on their land, was heavily dependent on this treatment and was designed to be easily upgradeable, if new information about any of the Australian *Rubus* species became available. Work continued in blackberry to find rust strains suitable as biological control agents against the various blackberry taxa recognised by

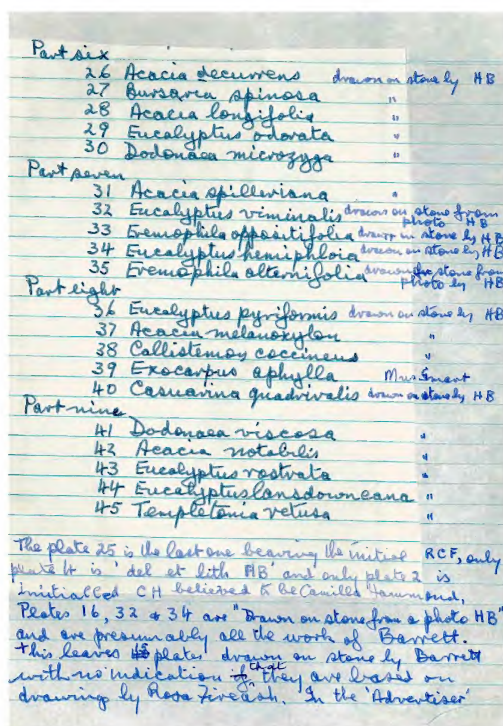


Fig. 3. David's characteristic handwriting. He always used a fountain pen and often cut and pasted various pieces of paper (as can be seen here).

David (Evans et al. 2003, Gomez et al. 2006, Morin et al. 2006) and David continued the work of providing identifications of the *Rubus* vouchers collected during field releases of new rust strains across Australia until around 2010. It became quite clear from these vouchers that there are further taxa present in Australia in need of clarification, but apparently no interest in updating of the taxonomy. Unfortunately this is a common response to the production of new taxonomic treatments and so there still remains unfinished work surrounding the circumscription of introduced *Rubus* in Australia.

Gypseous plants

In later years David developed an interest in gypseous plants (Symon 2000, 2007) and spent some time travelling and collecting these in South Australia, usually in the company of his wife Judy.

Dracaena

Two Dragon's blood trees, *Dracaena draco*, were planted in the Waite Arboretum in 1929, and it was from these that David's fascination with this group of trees grew. He published early (Symon 1974) on changes which had been observed in these two trees as they grew and proposed a means of determining the age of particular trees. During his time in charge of

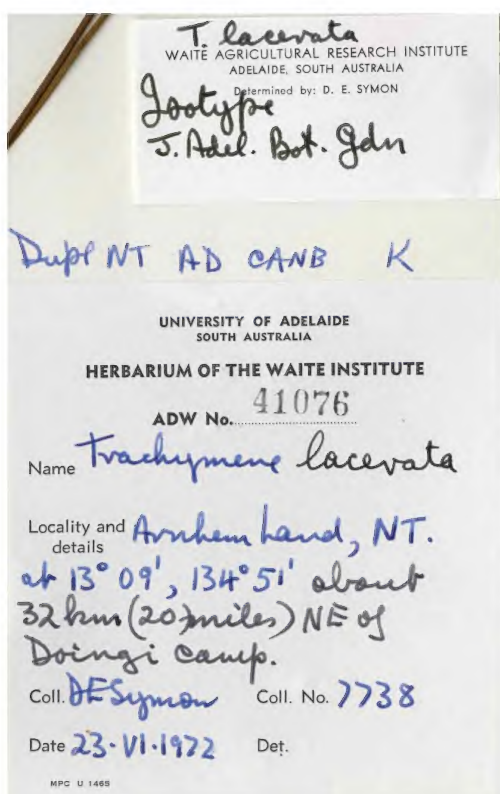


Fig. 4. Handwritten Waite Herbarium label and annotations by David on an isotype specimen of *Trachymene lacerata* Maconochie: D.E. Symon 7738 (ADW now incorporated into AD).

the Arboretum he was responsible for adding at least eight more *Dracaena* trees including one whose seed came from the iconic “thousand year old” tree³ in Icod, Tenerife, Canary Islands in 1967. David continued to work with his successor, Jennifer Gardner, to increase the collection in the Arboretum and there are presently some 21 *Dracaena* trees of varying ages, including nine *D. draco*. Two of these represent a new subspecies from Morocco only described as recently as 1997. Seed was obtained of these and the one planted out in 2001 had already flowered by December 2010 (Symon 2011). David had gathered together a history of the species and its close relatives, documenting its occurrence in Adelaide gardens and elsewhere, and estimating age from the growth form, intending to publish a booklet on the subject. It is appropriate therefore that the site of the

plaque celebrating David’s 90th birthday (Anon. 2010) and his service to the Arboretum (see Memorials below) was near one of the mature *D. draco* trees with some of the younger representatives nearby (Fig. 7). This same site was also the scene for his well-attended memorial service.

Weeds

David’s interest in weeds and their spread was a lifetime one — in the 1950s he was involved in the early identification of khaki weed (*Alternanthera pungens*) in South Australia; although the then Department of Agriculture took action and indicated it was controlled at that time, it remains an ongoing problem. Again in later years he became interested in documenting the spread of native species of *Solanum* and exotic grasses along the major highways of the State. With the appointment of Kew-trained Chris Brodie as Weeds Botanist at the State Herbarium in 2009, there was an instant rapport and Chris could not have had a better mentor than David from whom to learn, while David delighted in passing on his knowledge to Chris. Most of David’s collections from 2009 were weed collections in association with Chris (Fig. 6).

Botanical History

It is impossible to have the interests that David had without being interested in events of the past. David’s publications in this area encompassed the compilation of information about the differing content of the copies of Fannie de Mole’s *Wildflowers of South Australia*, the first book on the subject to be produced in South Australia (Symon 2001, 2003). He had a similar interest in the publication of Ednie Brown’s *Forest Flora of South Australia* and he and Eric Sims (Symon 1996, Sims and Symon 1997) unravelled much to do with the identity of the artists and lithographer associated with this publication, although there remains still some of this work to be documented in print.

Some of his major contribution to the Sturt pea book (Symon & Jusaitis 2007) surrounded the early history of the plant. He and Rosemary Taplin (Taplin & Symon 2008) looked into the history of Adelaide’s early nursery, Newman’s Nursery, to establish what had survived to the present day and when he encountered the name *Rubus sanctus* he was intrigued enough to research it and come up with the article on *Burning bushes* for the *ASBS Newsletter* (Symon 2005). Likewise, something that is relatively commonplace now, his was possibly the first documented study of early paintings of South Australia to glean information on the vegetation of that time (Symon 1990). These are just some of the items in whose origins and history David took an interest; others can be seen from his bibliography.

Curation

Officially David curated the families Frankeniaceae, Goodeniaceae, Leguminosae, Rosaceae and Solanaceae in the State Herbarium from 1986 and he was probably one of the few botanists in AD who found time to keep

³ The large tree at Icod is the symbol for the island and was originally estimated to be thousands of years old, but in reality is probably only 300 years old (Magdefrau 1975). Unfortunately the tree at the Waite was subjected to attack by corellas with removal of all of its leaves (Symon 2008) and since it is no longer listed in the Arboretum catalogue, it is presumed to have died.

the specimens in the vaults as up to date as possible. He also believed in collecting literature of a genus or family and keeping it with the collection, a custom he continued from his curation of the ADW collection at the Waite. In later years he was employed to identify collections of the Biological Survey of South Australia team and his distinctively signed determination slips and labels (Fig. 4) are to be found throughout the AD collection.

Floras

David was involved with the pre-political manoeuvres which eventually resulted in the establishment of the *Flora of Australia* project (see below), contributed a new key for *Cassia* to Eichler's *Supplement to Black's Flora of South Australia* (Symon 1965), produced accounts of the Caesalpiniaceae and Solanaceae for the Australian Systematic Botany Society sponsored *Flora of Central Australia* (Symon 1981), was part of the authorship of Solanaceae for the first taxonomic account in the *Flora of Australia* (Purdie et al. 1982) and then contributed Caesalpinoideae and major parts of Solanaceae and Rosaceae to the 4th edition of *The Flora of South Australia* (Symon 1986). Through his curation of the families cited above he also contributed to the various South Australian censuses published between 1983 and 2005 and continued to contribute to the State Herbarium's electronic census databases, CENSAP and subsequently FLORA, after that time.

Communication

David was an habitual letter writer, and this remained his preferred means of communication even when he had access to email. Some of his letters regarding his early field trips were reproduced in the *ASBS Newsletter* at the time of his life membership and he subsequently made a bound collection of them for his personal use (Symon 2001). When he was away interstate or overseas there would inevitably be postcards or letters from David to the "Herbs" with pithy observations in his large rounded hand (Fig. 3 & 4).

David was a good speaker, always very well prepared and, because of this, able to speak with authority on his subject. Much of this probably related to the necessity for him to present undergraduate student lectures in agronomy, but was also because of his deep familiarity with his subject. He was particularly unhappy when he had to listen to speakers who were ill-prepared or went over time — indeed after one ASBS conference where many of the overheads and slides had featured unreadable cladograms as well as speakers who exceeded their allotted time he was prompted to write a note to the *ASBS Newsletter* (Symon 1990) suggesting that organisations should insist on staff presenting their talks to a local audience before doing so at a conference. Those he considered too verbose with the spoken or written word often prompted Hamlet's appropriate "Words, words, words" as an annotation or mutter, and this quotation also featured in his pottery making (Fig. 5).



Fig. 5. Pottery plate made by David, inscribed with one of his favourite sayings.

The written word in letters was David's strength since it was more suitable for expressing his quick thoughts. He was not so good at writing scientific papers since the brevity employed in his letters extended to these papers and so many of them required considerably more work to expand his notes into a form suitable for publication. This is not to say that his original work was not good, just that his original, often lateral, observations frequently required considerable massaging before a coherent story was produced.

Books

It would be true to say that David loved books and was an inveterate reader across many topics. And many of those topics would later become the subject of discussion around the tea-room table. He was always one of the first to peruse the new books and journals when they were tabled in the Botanic Gardens & State Herbarium Library and the same was probably true of the Barr-Smith Library at The University of Adelaide, which he usually visited once a week.

From 1996 to 2000 he was one of 3 judges for the biennial non-fiction award of the Adelaide Festival of Arts Writers Week but even his love was stretched by the requirement to read and judge some 300 books in a relatively short space of time. Interestingly the first and third of the prizes awarded while he was on the panel went to Tim Flannery for *The Future Eaters* and *Throw'im Way Leg: an Adventure*, respectively, while the middle year went to David Day's *Claiming a Continent: A History of Australia*.

David contributed a number of book reviews, particularly to the *ASBS Newsletter* (Symon 1978(2), 1985, 1987, 1988(2), 1989(2), 1990, 1991, 1992(2), 1996, 1997(3), 1999, 2002, 2005(2), 2010), and more

occasionally to other journals such as *Society for Growing Australian Plants Journal* (Symon 1991), the *Friends of the Adelaide Botanic Gardens Gazette* (Symon 1996), the *Journal of the Adelaide Botanic Gardens* (Symon 1998) and the *Friends of the Waite Arboretum Newsletter* (Symon 1996).

Lucid Keys

David provided the original paper scoring of the characters for the families Solanaceae and Rosaceae for the cooperative Lucid key to *The Families of Flowering Plants of Australia* (Thiele & Adams 1999) and the revised edition in 2002. He played an advisory role in the production of the Lucid keys to Blackberry and Solanaceae (see below).

Supervision and advisory roles

While officially he supervised only 3 postgraduate students, there are countless others whose work owes much to David and you will see him cited in acknowledgements in papers, sometimes in somewhat surprising places — his net has been wide. Further probing will undoubtedly reveal other influences that have been missed here. While much of his advice will have initially involved identification, particularly in *Solanum*, *Nicotiana* and *Rubus* studies, he usually had further observations to add.

Formal supervision of theses

- Barbara Randell (Ph.D., Flinders University of South Australia, awarded 1970). *Biosystematic studies in Australian arid-zone Cassia species*. Supervisors Bryan Barlow and David Symon
- Laurence Haegi (Ph.D., Flinders University of South Australia, awarded 1984). *Systematic and evolutionary studies in the Australian Solanaceae*. Supervisors Bryan Barlow and David Symon
- Peter Kloot (Ph.D., Dept. of Agronomy, University of Adelaide, awarded 1986). *Studies in the alien flora of the cereal rotation areas of South Australia*. Supervisor David Symon.

Supervision through administration of ABRIS Grant

Laurie Haegi and Philippa Horton were both employed on an Australian Biological Resources Study grant awarded to David to complete work on *Datura* and *Nicotiana* respectively.

Acknowledged advisory role

David's expertise in the Solanaceae has been acknowledged in a number of theses:

- Christina Morris (Ph.D., Dept of Plant Biology, University of Birmingham, 1986). *A systematic study of old world members of the genus Solanum L.*
- Cassandra Collins (Ph.D., Dept of Horticulture, Viticulture and Oenology, University of Adelaide, 2002). *A study into the domestication of Solanum centrale, Australian bush tomato*
- Angela Dennett (Honours, Faculty of Agriculture, Food and Natural Resources, University of Sydney, 2006).

Underground structures and mycorrhizal associations of Solanum centrale (the Australian bush tomato)

- Graeme Morris Weavers (M.Sc., Biological Sciences, University of Waikato, 2010). *Ecological, genetic and cultural status of Solanum aviculare, poroporo (Solanaceae)*
- Claire Marks (Ph.D., School of Botany, University of Melbourne, 2010). *The evolution of Nicotiana section Suaveolentes*.

Blackberry

Julie Oliver and John Marshall of Flinders University, both of whom worked on blackberry under the supervision of Dr Molly Whalen, were originally dependent on David for advice and identification of the taxa.

Lucid Keys

David played an advisory role in the early stages of the production of the Lucid keys to Blackberry and Solanaceae (Barker & Barker 2005; Barker 2010) and his original work underpinned much of the information projected in these keys. While he recognised the value of the keys, they were not for him and he much preferred a written dichotomous key. However, he still gave freely of his time and knowledge when questions about species and their classification arose and did acknowledge their worth.

American collaborations

Greg Anderson, University of Connecticut, was awarded NSF grants in 1979–1980 to study the reproductive biology of *Solanum* in Australia and he based himself in Adelaide with David to carry out this work. One of Greg's students, Chris Martine, now of Bucknell University, Pennsylvania, came to Australia in 2004 on a collecting trip as part of his Ph.D. studies "*On the evolution, distribution and Natural History of dioecy in Australian Solanum*" and David was able to spend time in the field with him in Kakadu. Both of these projects relied heavily on David's knowledge of the group. Chris has just recently recounted his intention of describing a new species of *Solanum* in the Northern Territory, only to find that David had already annotated the material in the Darwin Herbarium several years ago and already provided a description (Martine 2013).

Botanical committees, societies and education

Many new scientific or special interest groups, local through to international, were formed during David's working life and though it is known that he had involvement with some, it is not always clear just what it was. Unfortunately the early documentation of small societies, or even some of the larger ones, is not always good, and even if the members are organised enough to produce a newsletter, the sort of information needed is seldom recorded or the newsletter has not been deposited in a library. And the societies, if they still exist, are still usually too young to contemplate a history of their activities. These statements apply to several groups with

which David was associated and it is a pity that some forethought was not given to getting him to write down his recollections of the early days of these societies and his involvement with them.

Coolabah Club

The Club was formed in 1959 after a group of farmers heard a lecture from David on the use of trees on the farm (Michelmore & Michelmore 1991). This was presumably the Adult Education course designed to encourage farmers to plant trees for shelter belts and for economic purposes, first conducted for 60 farmers in 1957. David ran the course, but included other speakers such as Noel Lothian (Botanic Gardens) and members of the Department of Woods and Forests, including Cliff Boomsma (see reproduction⁴ of article from Feb./Mar. 1957 in Barker 2012b, p. 14). The Club was formed at about the same time as the Society for Growing Australian Plants and was a forerunner to such groups as Men Of The Trees, Trees For Life, Greening Australia and Land Care, but in this case, as well as planting trees on their own land they also worked with the Highways Department in planting native trees on roadsides.

While David did not play a big part in the Club he was always there for advice and for tours of the Arboretum. He distributed *Pistacia atlantica* (Mt. Atlas mastic tree or Persian turpentine tree) to members of the Club in 1965 and there are occasional references to their progress in the Club's newsletter in later years. The tree is very slow growing and may well persist on farms which obtained it at this time, but since it is dioecious it is unlikely to become a weed problem of the future, unlike others. Likewise David distributed the ornamental pink-flowering eucalypt, '*Urrbrae Gem*', a seedling of which was discovered at the Arboretum by head gardener Fred Couzens, and is thought to be a cross between *E. erythronema* and *E. stricklandii*. The 1957 article mentioned above indicated that seed of this species had already been widely distributed and it had been "chosen by the Housing Trust for extensive plantings at Elizabeth".

Unfortunately the Club is now defunct and a whole lot of history concerning the planting of trees on farms in South Australia will be lost unless efforts are made to record it soon. Since the membership was at one time about 100 families this is not an insignificant contribution to the present vegetation of the State. The Botanic Gardens Library holds copies of newsletters of this society from c. 1981, but earlier ones are lacking and information will be lost unless action is taken to track them down.

Given his role at the Arboretum and his interests in Australian plants it is likely that David played a similar role with the Society for Growing Australian Plants (SGAP) particularly as the two societies had overlapping membership.

⁴ The original article has not been seen, but a cutting in David's possession was photographed for the article and can be read at this site (Barker 2012b).



Fig. 6. David during field work with Chris Brodie, 2010. — Photo: C.J. Brodie.

Australian and New Zealand Association for the Advancement of Science (ANZAAS) and the setting up of the Flora of Australia

Long the umbrella body for Australian scientists, with plant systematics represented under the Botany subgroup, ANZAAS was the normal vehicle of communication between plant systematists in Australia and New Zealand up until the formation of the more specialised Australian Systematic Botany Society and the formation of the Council of Heads of Australian Herbaria (CHAH). Even the earlier association of plant systematists, who published *Australasian Herbarium News* from 1947–1954, was governed by an ANZAAS established committee. David spoke on "The subgeneric limits in *Solanum*" at the ANZAAS conference in Adelaide in 1969, and also at the 1973 Perth meeting (see above), but no further investigations have been made into his certain contributions to other conferences conducted by them, primarily because very few of their proceedings are available in our library.

ANZAAS was also instrumental in setting up a *Flora of Australia* Committee in 1959 "to prepare estimates and detailed plans of the organisation required for the preparation of a new *Flora Australiensis*". David was part of this committee, which recommended the production of a new monographic *Flora of Australia* (Blake 1960, cited in George et al. 1999). He was also part of the later *Flora of Australia* Standing Committee, set up by the Academy of Science in 1971 (Catcheside 1974), and later, when the *Flora of Australia* became a reality, he was a member of the first *Flora of Australia* Editorial Committee from 1980 to 1984. This inaugural



Fig. 7. David sitting on the plaque that was unveiled at his 90th birthday, in front of his favourite *Dracaena* tree, Oct. 2010. — Photo: D.E.A. Catchside.

editorial committee was responsible for deciding the format that the *Flora* took. Five volumes, including the Introduction and Solanaceae, were produced in the time that David was involved with the committee.

Royal Society of South Australia

The other outlet in South Australia for scientific endeavours when David was beginning his career as an academic was the Royal Society of South Australia. David first gave a talk to the Society in August 1959 on *The history and domestication of subterranean clover* and was elected as a member of the Society in 1962. He published some of his earliest papers in their journal.

Nature Conservation Society of South Australia (NCSSA)

Formed in 1962, it is known that David had a very heavy involvement with the Society until at least 1986, primarily through participation in botanical surveys and often the writing up of the results of these surveys (see Symon 1967(2), 1968(3), 1969, 1971, 1973(3), 1975(2), 1977(4) & 1985(2), Symon & Weber 1973, Symon & Copley 1986, and Harris, Reeves & Symon 1982). He served at least one term as President of the Society, but details are sketchy.

Council of Heads of Australian Herbaria (CHAH)

Under apparently somewhat controversial circumstances David attended the meeting that was to form

this group in 1972. As a representative of a university herbarium he was only granted observer status (see Briggs 2003).

The Flora and Fauna of South Australia Handbooks Committee (1972–1994)

David had a long involvement with this committee, first set up in 1921 at the suggestion of J.B. Cleland, for scientists to produce works on the flora and fauna of the State and for these to be printed by the Government Printer. His involvement was at a particularly productive time with volumes being produced on fish, plant feeding bugs, butterflies, amphibians, lichens, mosses, acacias, orchids and marine invertebrates as well as the 1986 edition of the *Flora of South Australia*. He contributed as an author to the updated 1986 edition of the *Flora* and also produced a revised edition of the handbook on acacias (Whibley & Symon 1992).

With the abolition of the position of Government Printer the Committee was wound up in October 2001 (Zeidler 2002).

Journal of the Adelaide Botanic Gardens (1978–2002)

David was listed as a consultant botanist from the third part of volume 1 (1978). At this time he was still employed at the Waite Agricultural Research Institute. He continued to be listed as such until 1993, after which he was included as part of the editorial committee; he continued to be listed in this role through to volume 20 (2002).

Australian Systematic Botany Society

David attended the meeting in Melbourne in April 1973 where the proposal was first made to form the Society and although he never held office, believing that was for the younger generation, he supported the Society through the newsletter and participation in local ASBS meetings.

He was the South Australian chapter convener in 1982/3. The chapter held monthly meetings from its inception in 1974 until 2001, when these were suspended for lack of attending members. David attended every meeting that he was available and though the membership present might have been small in later years and it therefore became difficult to invite outside speakers, the discussion part of the evening was invariably very rewarding to both speaker and those members present, often because of some of David's more probing or lateral questions or because of further observations he was able to add from his intimate knowledge of the flora. David's participation in Society events was documented in the *ASBS Newsletter* when he was awarded Life Membership of the Society in 2000 (Barker 1997, 2000).

David was invited by his peers to give the 1986 Nancy Burbidge Lecture at the ASBS meeting in Brisbane and obliged with a talk entitled *The diversity of Solanum fruits: a world survey*. He participated in the 'History Symposium' of 1988 when he used his study of early Adelaide paintings in the Art Gallery of South Australia

to discuss the early vegetation of the Adelaide region (Symon 1990) and he and his wife Judy formed part of the 2008 Adelaide Conference dinner entertainment with their renditions of Australian poetry containing references to plants. He undoubtedly contributed further as a speaker at other ASBS conferences, but there is not a complete collection of conference booklets in our library.

International Solanaceae conferences

Scientists working on many of the larger economic plant families have formed their own alliances and have their own conferences (grasses, orchids etc.). With the production of the first *Solanaceae Newsletter* by Richard Lester, University of Birmingham, England, in 1974, the first Solanaceae conference soon followed in Birmingham in 1976. David attended and spoke at this meeting (Symon 1979) and at the subsequent two meetings in Missouri, USA, in 1982 (Symon 1986) and Bogota, Columbia in 1988 (Symon 1991). David's account of the trials of getting to the latter conference is given in a reproduction of a letter published in Barker (2000).

The 4th International Solanaceae meeting was held in Adelaide in September 1994 with David as the main organiser and part of the international publishing team for the proceedings (Nee et al. 2000). He was still involved in the presentation of a paper (Lepschi & Symon 2000) and also a separate treatise on the kangaroo apples (Symon 1994). These Solanaceae meetings have continued on, but David was unable to attend any more, although he remained in letter and email contact with many of the participants.

With his broad interests in Solanaceae, David supplied Australian Solanaceous material for DNA studies to his colleagues around the world (e.g. Garcia & Olmstead 2003) or more recently he was involved in the gathering of fruits of Kangaroo Apples from various sources for study of their flavour and aroma for collaborative work with Dr Kerry Wilkinson, Wine and Horticulture, The University of Adelaide.

Friends of the Adelaide Botanic Gardens

Like most of the botanists of the State Herbarium, David was not a member of this group, but gave freely of his time in educating the members. In the early days of the Friends of the Adelaide Botanic Gardens, he provided tours of the Waite Arboretum on weekends, something that he was later to continue to do for the Friends of the Waite Arboretum (see below).

Friends of the Waite Arboretum

David was an inaugural member of this group when it formed in 1997 and participated in a number of ways. Always popular as a speaker, he contributed as the entertainment for several fund-raising dinners, where he gave a background to the plants making up the dishes consumed. He and Judy gave poetry readings from the poems he was accumulating on Australian plants (Bird 2008, 2009) and he was a long time guide for the walks offered to the public once a month on a Sunday morning.

He was a fount of knowledge through his association with the Arboretum since the 1950s and his work there has been recognised with a tree, a seat and a plaque (see below). David only retired from providing guided tours of the Waite Arboretum at the end of 2010 when walking became more problematic.

Tree and Roadway Experimental and Educational Network (TREENET)

Again an inaugural member of this society, which held its first symposium in 2000 after earlier meetings as the Urban Tree Cooperative Research Group. David participated in all of the early symposia and it was his selection of the cultivar 'Lynington' of *Pyrus calleryana*, a flowering pear, that was initially promoted by the Network. This group has now become an Australia-wide body renowned for their work on all aspects of street trees and it very appropriate that it has its home at the Waite Arboretum where so much knowledge about the growth of trees has been accumulated since the 1920s.

University of the Third Age (U3A)

I have no details, but David lectured on botanical subjects at the Adelaide branch of the University of the Third Age for some years.

Honours

- D.Sc., University of Adelaide, awarded 1996 (Fig. 8)
- Life member of the Australian Systematic Botany Society, awarded 2000
- Elected a Corresponding Member⁵ of the Botanical Society of America 2010.

Memorials at the Waite Arboretum and the Adelaide Botanic Gardens

David's contribution to the Waite Arboretum had already been recognised by Tree no. 496, *Quercus agrifolia*, planted on 25th July 1984. The inscription which accompanies the tree is as follows:

D.E.Symon. South Australian botanist. In charge of the Waite Arboretum 1956–85. During this period changes in policy were made and summer watering ceased. A 'homocline' approach was used in the introduction of tree species. Recording of data was intensified.

There is also a seat in the Arboretum which marks David's time as curator from 1956–1985.

In October 2010 a plaque was unveiled under one of David's favourite dragon trees (*Dracaena draco*) to mark his 90th birthday and his contribution to the Arboretum. Images of the occasion, the plaque and the seat can be seen in Barker (2012).

On National Tree Day, 28th July 2013, a *Capparis mitchellii*, originally grown by David and given to Barbara Wheaton, was planted in his memory in the mallee section of the Adelaide Botanic Gardens.

⁵ Corresponding members are distinguished senior scientists who have made outstanding contributions to plant science and who live and work outside of the United States of America. Corresponding members are nominated by the Council and have all the privileges of life-time members.



Fig. 8. David and Judy Symon in May 1996, after David was awarded the degree of Doctor of Science by The University of Adelaide. — Photo: W.R. Barker.

Unfinished projects.

Solanum — a new species from the Litchfield area in the Northern Territory is in the process of being published by Chris Martine (Martine 2013). Female flowers of this dioecious species, recognised as new by David some years ago, have been difficult to locate, accounting for the delay.

Nicotiana — there are two matters in need of clarification:

- an unpublished species with an existing phrase name, *Nicotiana* sp. *Corunna* (D.E.Symon 17088) Symon. Claire Marks (pers. comm., 2010) considers this to be a distinct species and it is likely to be published by her in collaboration with a group from the Royal Botanic Gardens, Kew, who are working on chromosomal evolution in the genus (J.G. Conran, pers. comm., 2013).
- the re-introduction of an old name, *N. exigua* H.-M. Wheeler, for specimens from the Strzelecki region following record rains. My opinion is that this needs to be looked at very carefully since it seem unlikely that a name based on seed collected from Dalby in SE Queensland would relate to plants arising after floods in the Cooper Creek system.

Manuscript of Rosaceae for the *Flora of Australia* — David's handwritten manuscript was sent to ABRIS in

Canberra for typing some years ago. A copy is held in Adelaide and this work will form a basis for treatments in the *Flora of Australia* and the *Flora of South Australia*

Dragon's blood tree — preparation of a booklet on *Dracaena draco* and its allies (see above). This manuscript is presently with Geoffrey Bishop, but it will need quite a lot of work if it is to progress further.

Medics — a history of the introduction of clovers in South Australia (see comments above).

Ednie Brown — a background to the man and his *Forest Flora of South Australia*, with clarification of who produced what in each of the plates. David's part of this has been completed, but joint author, Robyn Barker, has still to finalise her portion of the manuscript.

Australian plants in verse — with the completion of the *Sturt Pea* book (Simon & Jusaitis 2007), David became preoccupied with bringing together a publication on the treatment of Australian plants from the collected poetry of Australia. He spent hours poring over poetry books, collecting together those that they thought warranted the term 'poem' rather than doggerel and discussing them with Judy and his associates at the Herbarium; in this way he had gathered together some two thousand poems. Choosing between these poems, considering how they should be presented and getting permission to have them reproduced, unfortunately, rather foundered this project, but hopefully, progress may still be able to be made with it. David and Judy gave several popularly received readings to the Friends of the Waite Arboretum and one to the Adelaide ASBS Conference dinner in 2008.

Conclusion

David's was an active and productive life, and also a blessed one, lived as it was primarily in good health, in the days when academics still had time to grow and reflect and to enthuse students with their own passions and to enjoy study leave for its original purpose. The pace of life suited David with his enquiring mind, his handwritten letters and being able to hand over a manuscript and expect it back beautifully typed. Even if there was more personal discomfort, the slower pace of long and arduous field trips in areas where bitumen roads did not exist was more conducive to observation and reflection on the vegetation and not just a race to an already documented plant in order to make collections. The comparative lack of red tape during his academic life, compared with today, has to have been an advantage, as too the knowledge that his family was being well-looked after by a wife who took on the major responsibility of bringing up the family rather than seeking her own career. And despite all of his wide interest in plants there still remained time for his family and for those other non-plant pursuits that he loved, such as reading and the theatre.

Acknowledgements

Many thanks to David's family and herbarium colleagues, who contributed in so many different ways to this review of his scientific life. As with any such account there are some gaps, particularly with his early involvement with various societies, but it is hoped that the coverage is sufficient to do justice to this remarkable man.

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Appendix 1

Plant collections held by the State Herbarium of South Australia

David's numbered collections began in Nov. 1959 with his first numbers being collected in the Grampians in Victoria. However, he had made numerous collections before this time and an attempt has been made to document these from information compiled from plant label data entered in ADHERB, the collections database of the State Herbarium of South Australia. A few of these specimens do have collector's numbers, but the numbers do not appear to bear any relationship to the numbered collections after 1959.

Pre-numbered collecting books (Table 1)

David made at least two major collecting trips before he adopted the sequential numbering system. The first of these was the 'Central Australia Expedition' about which David wrote

My first field trip was in 1953 when the University of Adelaide funded an educational trip for C.S. Bauer, "Fred" Jessup, P. Madge, P.G. Martin, G. Mayo, K. Phillips and D. Symon to Central Australia. In two vehicles we drove to Alice Springs, the Hartz Ranges, McDonnell Ranges, Ayers Rock and the Olgas. It was successful despite some tensions within the party and all remembered it to their dying day (only two participants still survive). This was before my

botanical career began and the plant collections were sadly inadequate. Considering University stringency these days it seems inconceivably generous. The only paper resulting directly from the trip was Symon (1955) on *Cassia*.

Symon in Barker (2000)

The second major trip was a seed collecting venture to the Mediterranean in 1956 funded jointly by the Waite Institute and the Food and Agriculture Organisation (FAO) of the United Nations. David's brief was to collect pasture seed and he travelled for much of the time with two Swedish plant breeders, Gösta Olssen and Sven Ellerstrom, who were collecting *Brassica* and *Beta*. While there is no evidence of any vouchers from this trip amongst the collections in AD, there are cultivated collections of *Hordeum* grown at the Waite Institute in 1959 from seed collected from that time. Notes on these collections give the original seed collection locality, usually with a date, and from these it is possible to say that David visited Greece, Italy, Yugoslavia, Turkey and Malta between February and August of 1956; more precise localities are given in the notes on each of the specimens. We also know that he visited the walls of the Monaco Palace in an attempt to collect some *Brassica* seed, but was foiled by palace security (Barker 2012b). Clearly David collected more than *Hordeum* on this trip and it remains to be seen whether any herbarium specimens surface. The lack of mention of herbarium

specimens in letters which he wrote home at the time (Symon 2001) and the difficulty that carrying a press would have caused, suggest that vouchers are unlikely. Nor is it known what happened to the original seed collections.

Sequentially numbered collections (Table 2)

While his collecting books are deposited in AD they are not always terribly informative. With the earlier AD collector's book, David detached all of the informative details to go with the specimen, leaving only the stub with the number and, usually, an identification. When using the later collector's books, he did not make use of the duplicate sheet meant to be retained in the book

and seems to have merely used the book as a means of keeping the numbers of his collections sequential. Often there is only the name of the plant given and the details must have been provided to the databaser on a separate piece of paper, rather than being entered in the collector's book. For this reason much of the following information was originally compiled⁶ from the collector's books with confirmation from the collections database (ADHERB) of the State Herbarium of South Australia. The output does indicate that numbers were collected out of sequence on a number of occasions.

⁶ After having compiled the list, I came across David's own list of his collections up until 2002 and so that has also been used in checking the information below.

Table 1. Pre-numbered collecting books of D.E. Symon (before Nov. 1959).

Year	Number of collections in ADHERB database	Locality	Comments
1946	27	all Adelaide environs, mostly Roseworthy College	Un-numbered
1947	3	SE, SL	Un-numbered
Oct. 1948	10	8 of the collections are identified as <i>Medicago polymorpha</i> L. var. <i>polymorpha</i> from near Adelaide	The medics numbered 3–16, with a single sheet bearing up to 3 numbers
1949	0		
1950	c. 7		
1951	53 (22 of these in May from Qld)	The 22 specimens from Qld were all grasses, except for 2 <i>Xanthorrhoea</i> , and all from the Gatton area, Qld (while based at Gatton Agricultural College)	Un-numbered Graduates Adelaide University B.Ag.Sc. (Hons)
1952	176 total	c. 62 of these collected in NSW and Vic from 12–21 Jan. with M.V. Carter; 27 from Yorke Peninsula between 8–10 Oct.	First year as Lecturer in Agronomy Department, Uni of Adelaide
1953	862 total	c. 780 collections from 15 May–27 June from 'Central Australia Expedition' (see text)	Mostly un-numbered; for those few with numbers their significance is not obvious
1954	108 total	March: 42 collections from Kangaroo Island, SA September: 22 collections from Armadale, Kojonup and Merredin, WA	
1955	32 total	From various areas in SA, 3 of them cultivated plants	
1956	3 total	Seed collecting of cereals, pasture grasses and clovers in the Mediterranean between May and August	Appointed Systematic Botanist at the Waite (Gardner 1990) There is no obvious evidence of the Mediterranean collections in the herbarium and it is not known whether there were voucher collections made to accompany the seed collections, but it seems unlikely
1957	37 total		Marriage
1958	164 total	58 collections on 13 Nov. from Yorke Peninsula	All un-numbered
1959	427 un-numbered collections (numbered collections began in Nov. 1959)	239 collections on 21 Sep.–2 Oct. from Nullarbor and Eyre Peninsula 32 collections on 26 Oct. the harvested plants from seeds of Mediterranean <i>Hordeum</i> planted at Waite on 1 Apr. 1959	Beginning of sequential numbering system, but these collections un-numbered or (<i>Hordeum</i> specimens) with a number not related to the DES sequence below

Collections from one trip or locality have been indicated for each year and the first number for the start of each year is indicated in bold. The total number of collections for each year has also been given, but these numbers can only be approximate, because of the quite significant number of unnumbered collections, especially of cultivated plants, the lack of databasing of some of these, as well as the lack of databasing of some interstate and all overseas collections. The yearly total given usually exceeds that of the collector's book numbers because of un-numbered collections as well as the inclusion of collections in which David was not the principal collector.

David also grew many plants of interest to him in pots either in the home garden at Tusmore or at the Waite Institute. Many *Solanum* and *Nicotiana* species in particular, were grown on from his field collections and further observations, and sometimes photographs, made of their attributes. This practise was not confined to Solanaceae and was quite frequently used for non-flowering specimens which were grown on until they had flowered.

On some of his longer trips, David often had interesting companions. In February 1965 he accompanied Professor Tom Browning to the Dalhousie Springs area to collect kangaroo ticks, managing to still collect over 200 specimens despite the difficult travel. In 1967 he was part of the archaeological dig led by R.V.S. Wright of the Australian Institute for Aboriginal Studies at Koonalda Cave (Wright 1971), again collecting over 200 specimens. He accompanied David Collins and Frank Eastwood of Monash University on a long trip

through Western Australia and Northern Territory in search of *Solanum* alkaloids in 1975 (see Collins 2013 for an account of this trip). To name just a few, he was accompanied by botanists Bryan Barlow of Flinders University (1967), John Maconochie, Norm Byrnes and Peter Latz of the Alice Springs Herbarium (1971, 1972) and Greg Anderson of the University of Connecticut (1980) on Australian *Solanum* forays and in Papua New Guinea was accompanied by nationals Michael Galore, Paul Katik and Aubeta Kairo (1977 and 1984), the latter two renowned for their knowledge of the PNG flora.

David was also heavily involved in surveys of particular areas of conservation significance in South Australia. During his working life and through his involvement with the newly formed Nature Conservation Society of South Australia (N.C.S.S.A.), he was heavily involved in surveys in areas which were already, or would later become, national parks or reserves (e.g. Hambidge, Hincks, Oraparinna, Gawler Ranges, Carapee Hill, Innes, Coorong and Ninety Mile Desert) as well as joining a Royal Society of South Australia expedition to the Pearson Islands. After his retirement in 1985, he joined a number of the National Parks and Wildlife Service biological surveys. Where a report is known to have been prepared as a result of a survey the reference has been indicated in Table 2, but the list is not exhaustive and should be taken as an indication only. Some of his collections on these surveys were made using a NPYE, or later, a BS number; these are indicated in the list.

In the last 2 years most of David's collecting was done in association with the State Herbarium's Weeds Botanist, Chris Brodie, under Chris's collecting numbers.

Table 2. Sequentially numbered collections of D.E. Symon (from Nov. 1959)

Year (number of collections in ADHERB in brackets)	DES collecting numbers with additional Biol. Survey numbers (NPYE and BS)	General locality of collections, remarks
1959 (299)	1–	
3 Nov.	1–111	Grampians, Vic
8 Nov.	114–141	Port Fairy, Vic
9 Nov.	142–299	Grampians, Vic
1960 (857)	332–	
24 Jan.	301–306	Yorke Peninsula
25 Jan.	309–329	Mt Compass
20 Feb.	330–365	Waite environs
23 Feb.	377–403	Salisbury & Main North Road
11–13 Apr.	430–514	Mambray Creek, Pt Augusta–Mundallio Pound, Horrocks Pass–Mt Remarkable
13–19 Sep.	539–716	Wilpena
27 Oct.	775–818	Saddledworth
11–15 Nov.	830–970	Tumby Bay environs
12–17 Nov.	971–999	Wilpena, Flinders Ranges
1–11 Dec.	1000–1159	NW SA to Eyre Peninsula with Tom Browning–Arcoona, Andamooka, Stuart Ck, Billa Kalina, Anna Creek, Commonwealth Hill, Kingoonya, Whyalla
1961 (725)	1166–	
6–9 Mar.	1168–1213	Mt Gambier environs
25 July	1245–1272	Happy Valley reserve
30 Aug.	1273–1306	Florierton, Bower, Sedan

4–10 Sep.	1307–1439	Wilpena, Aroona, Brachina, Arkaba (Flinders Ranges)
14 Sep.	1440–1499	Winulta, Yorke Peninsula
12 Oct.	1533–1596	Waite plots in Happy Valley Reservoir Reserve
25 Oct.	1604–1640	Adelaide Hills, Blakiston etc.
30 Oct.–8 Nov.	1641–1870	Horsham, Grampians, W Victoria
28 Nov.	1895–1922	Happy Valley Reservoir Reserve
1962 (928)	1944–	
1–2 Mar.	1951–2030	Yorke Peninsula
7 Mar.	2036–2070	Upper Murray River
11 Mar.	2071–2079	Millbrook
14 Mar.	2080–2096	Port Augusta, lower Flinders Ranges
11 Apr.	2097–2116	Happy Valley Reservoir Reserve, Waite plots
28–30 May	2127–2154	Wilpena, Parachilna, Blinman
30 July–14 Aug.	2155–2748	Musgrave, Tomkinson, Rawlinson, Mann, Sir Frederick and Walter James Ranges, Hopkins Lake, Schwerin Mural Crescent, Giles, Mt Lindsay, Piltadi, Mt Woodroffe, Kenmore Park, Woomera
13 Sep.	2752–2766	Roseworthy College
3 Oct.	2767–2872	Happy Valley Reservoir Reserve, Waite plots
1963 (27)	2875–2884	West Beach
1964 (449)	2885–	
11–14 Aug.	2900–2931	Koomooloo, Bungaree, Crystal Brook, Maitland, Moonta–Waite Agricultural Science students tour.
	A competing numbered set, indicated in italics, appears to have begun here, possibly because of the involvement of students:	
	<i>DES 1–c. 50.</i>	
14–17 Sep.	<i>DES 82–115</i>	Environs of Waite Agricultural Research Institute
1 Oct.	2951–2958	South East student tour
	<i>DES 119–151</i>	
10–13 Oct.	2959–3106	Pt Augusta, Flinders Ranges, Gammon Ranges
	<i>DES 154–163</i>	
Oct. (s.dat.)	2816–2872	Waite plots environs, Mt Compass
20 Nov.	3107–3164	Roadside about property of Mr. Thomas, ‘Bundaleer’, Monarto South
29 Dec.	3167–3178	Blanchetown
1965 (801)	3180–	
10–23 Feb.	3219–3452	Dalhousie Springs with Tom Browning: Strangways Spring, Everglades, Mt Dare, Everard Park, Mt Illbillie, Commonwealth Hill, Woomera, Lake Bring, Wynbring, Tarcoola, Kokatha, Moonaree, Whyalla
21–26 Aug.	3457–3514	Grampians, Victoria
7 Oct.	3526–3585	Morgan
9–12 Oct.	3586–3897	Overland Corner, Oak Dam, Calperum
16 Dec.	3899–3947	Clare, Mintaro
1966 (621)	3949–	
1–5 Mar.	3963–4052	Flinders Ranges, Mt McKinley, Mt Serle
8–10 Oct.	4078–4323	Hambidge Reserve, Eyre Peninsula (N.C.S.S.A.). See Symon & Krachenbuehl (1967)
1–2 Nov.	4331–4405	Simpson Desert. See Symon (1969)
9 Nov.	4406–4449	Mortlock Experimental Station, Mintaro
1967 (1087)	4474–	
13–25 Feb.	4481–4697	Eyre Peninsula, Koonalda Caves (archaeological dig led by R.V.S. Wright). Account in Wright (1971). One of David’s letters home in Symon (2001) is from this expedition
15 May–3 June	4743–5044	Cultivated Solanaceae: N Qld–Townsville, Atherton, Laura, Coen, etc., to Darwin (Northern Territory) with Mary Clark (cousin) and then Darwin, to Kalgoorlie (Western Australia) with Bryan Barlow, Flinders University
4–18 June	5045–5242	Hundred of Blesing, Peninsula (N.C.S.S.A.). See Symon (1968)
19 June–6 July	5243–5478	
1968 (1113)	5505–	
14–26 Aug.	5520–6102	Strzelecki to Flinders Ranges

8–13 Oct.	6108–6559	Hincks Reserve, Eyre Peninsula (N.C.S.S.A.). See Symon (1968)
8 Nov.	6565–6598	Mortlock Station, Mintaro
1969 (279)	5891–	
6–18 Jan.	6602–6681	Pearson and Dorothee Islands (Royal Society of SA). See Symon (1971)
19–22 June	6729–6752	Broken Hill area, NSW
5–6 Sep.	6761–6797	Flinders Ranges
	6798–6878	Cultivated from Pearson Island soil (mostly not databased)
1970 (12)	None of sequential numbers used	
1971 (705)	6881–	
16 May–10 June	6895–7191	Kimberleys–Yuendumu, Tanami, Hooker Ck, Victoria River Downs, Broome, King Leopolds, Kalumburu with Alice Springs Herbarium staff John Maconochie and assistant Greg, Norm Byrnes and cook, Curly
12–20 Sep.	7193–7547	Flinders Ranges, Oraparinna
8–10 Oct.	7558–7588	Oraparinna National Park (N.C.S.S.A.). With C.R. Alcock, S. Barker, E. Jackson, R. Nash and J. Weber. See Symon (1971)
1972 (909)	7590–	
16 Jan.	7590–7624	Miltadie, Eyre Peninsula, collections by Roy Pearce under DES numbers
12 June–5 July	7637–8010	Northern Territory–Arnhem, Gove, Darwin with Alice Springs Herbarium staff, John Maconochie, Peter Latz and Norm Byrnes, Bob Fox and Jenny ?Harmer (nee Must)
16–18 Sep.	8013–8033	Flinders to Lake Frome
1–10 Oct.	8037–8379	Gawler Ranges (N.C.S.S.A.). See Symon (1975)
1973 (449)	8380–	
8 Jan.	8380–8450	Wingelena, Blackstone Ranges, Western Australia (nickel mine)
21–28 Jan.	8451–8506	Kangaroo Island
9–10 June	8534–8577	Belacre, Meningie, upper South East (student tour)
20–25 Oct.	8581–8786	Scorpion Springs Conservation Park (N.C.S.S.A.). With J. Carrick and E. Jackson. See Harris, Reeves & Symon (1982)
1974 (1099)	8801–	
14–16 Sep.	8822–9052 (also 9678–9681)	Carrappee Hill, Eyre Peninsula (N.C.S.S.A.). See Symon (1975)
18–30 Sep.	9075–9484	NE SA–Oodnadatta–Dalhousie, Simpson Desert, Purni Bore
6–11 Oct.	9485–9699	Innes National Park, Yorke Peninsula (N.C.S.S.A.). See Symon (1977)
26 Nov.	9701–9757	Monarto
1975 (819)	9771–	
27 Jan.–7 Feb.	9778–9894	<i>Solanum elaeagnifolium</i> trip: Vic.–NSW with Roy Pearce
11 May–12 June	9908–10387	Western Australia–Kalgoorlie, Leonora, Wiluna, Meekatharra, Wittenoom, Broome, Mt Leopold, Kalumburu, Tablelands, Wyndham, Baines River, Alice Springs with David Collins and Frank Eastwood (Monash University)
9–12 Oct.	10395–10559	Coorong (N.C.S.S.A.). See Symon (1977)
1976 (69)	10584–	
1977 (271 + 83 PNG)	10617–	
	10623–10707	Papua New Guinea (specimens not yet databased). With Nigel Clunie, Paul Katik, Michael Galore
1–?8 Oct.	10710–10930	Mt Shaugh Conservation Park, Comet Bore, Scorpion Springs Conservation Park (N.C.S.S.A.). With C.R. Alcock, E. Jackson and J.G. West. See Harris, Reeves & Symon (1982)
1978 (547)	10975–	
23 Sep.	11035–11103	Pt Davenport, Yorke Peninsula
1–6 Oct.	11104–11445	Mound Springs, Lake Eyre (N.C.S.S.A.). See Symon (1985)
21–22 Oct.	11448–11481	Arckaringa Hills
1979 (783)	11511–	
10–23 Jan.	11514–11534	NSW–Dorrigo–Myleston
11–16 Sep.	11575–11588; s.n.	River Murray, Chowilla (J.S. Womersley 543–638 & D.E. Symon). Reconnaissance houseboat trip for International Botanical Congress tour in 1980 with W.R. Barker et al.
29 Sep.–2 Oct.	11596–11827, 11947–11950	Marble Range, Eyre Peninsula (some anomalous numbers). (N.C.S.S.A.)

3–4 Nov.	11838–11956	Pt Davenport, Yorke Peninsula
16 Nov.	11762, 11928–11943	Waite property at Sandergrove, S of Strathalbyn
1980 (910)	11959–	
4–8 Jan.	11959–11989	Oraparinna, Flinders Ranges
1–22 April	11998–12142	Northern Territory—Western Australia (Kimberleys): <i>Solanum</i> trip with Gregory J. Anderson, University of Connecticut
16–30 Aug.	12158–12772	Great Victoria Desert (N.C.S.S.A.). See Symon & Copley (1986)
8 Oct.	12781–12810	Loxton
1981 (209)	12831–	
4 Apr.	12838–12849	Whyalla
10 Dec.	12885–12937	Mintaro, Clare area
17 Dec.	12939–13016	Southern Hills
1982 (60)	13020–	
1–2 Nov.	13030–13062	Oraparinna, Flinders Ranges
1983 (695)	13065–	
20–26 June	13109–13217	Dalhousie with Brendan Lay
23–26 Aug.	13231–13250	Students tour, mid North
12–13 Oct.	13251–13345	Milang, southern Hills
		Morgan–Cadell
14 Nov.	13377–13497	Kuitpo
		Waite environs
18–20 Dec.	13509–13714	Porter Bay near Port Lincoln (with David Morgan)
1984 (982)	13214–	
+ 97 PNG)		
25 Jan.	13716–13783	Southern Hills
6–7 Mar.	13785–13797, 13904	Student tour, Upper Murray
15 May–17 June	13799–13896	Papua New Guinea (specimens not yet databased)
5 Aug.	13905–13925	Burra – Morgan
9–13 Oct.	13935–14196	Moralana Station
1985 (37)	14203–	
1986 (40)	14236–	
1987 (1113)	14269–	
7–13 Jan.	14269–14296	Kangaroo Island
28 May–6 June	14352–14595	Dalhousie, Purni and other bores (botanical assistance to Geography Department, University of Adelaide party, doing pollen sampling, etc.) See Boyd (1990)
9–15 July	14599–14704	Moralana Station
5–20 Oct.	14706–14801	SA NPWS Yellabinna Survey: mixed survey and DES sequential numbers. Some have been databased in the wrong sequence. See Copley & Kemper (1992) for results of this survey
	NPYE 1001–1627	
1988 (46)	14806–	
1989 (134)	14850–	
8 Apr.	14854–14874	Torrens Linear Park, Adelaide
28 June–6 July	14880–14890	Qld/NSW
2–4 Nov.	14901–14971	Moralana Station
1990 (55)	14974–	
	14974–15023	Eyre Peninsula
1991 (116)	15045–	
22–26 July	15053–15108	Biological Survey 24: South Olary Plains, with D.E. Peacock. Some later DES numbers used out of sequence. See Forward & Robinson (1996) for report.
	BS24 52407–52484	
1992 (357)	15109–	
5–7 June	15109–15131	Moonta area, Yorke Peninsula
26–30 Oct.	15135–15137	Biological Survey 49: Mid-North, with D.J. Brock
	BS49 1874–2198	
1993 (54)	15138–	
1994 (149)	15156–	
25–28 Jan.	15176–15185	Victorian Alps
24–30 Oct.	15196–15212	Eyre Peninsula
1995 (418)	15224–	
26 Sep.–5 Oct.	15235–15283	Biological Survey 69 Stony Deserts, with V.L. Lashmar. See Brandle (1998) for report
	BS69 26853–27135	

22–23 Nov.	15284–15322	Mount Gambier area
1996 (556)	15326–	
17–25 Sep.	BS69 29601–30018	Biological Survey 69 Stony Deserts, with R.A. Last. See Brandle (1998) for report
Nov.–Dec.	15362–15427	Mostly <i>Rubus</i> from SL and SE regions, and misc.
1997 (576)	15428–	
Jan.–Feb.	15428–15481	Mostly <i>Rubus</i> from SL and SE regions
5–12 Apr.	DES 15482–15649 HPV 2300–2481	Lake Eyre region after flooding with H.P. Vonow and H. Smyth
29 Apr.–1 May	15655–15706	Cooper Pedy–Oodnadatta area with Judy Symon
1–29 Dec.	15709–15764	Rosaceae, particularly <i>Rubus</i> , SA
19 Dec.	15897–15908	<i>Rubus</i> collections, Victoria, with J.R. Hosking (anomalous numbers since entered in database as 1997, rather than 1998; see below)
1998 (171)	15768–	
Jan. 1998	15768–15776	<i>Rubus</i> (blackberry) cultivars
28 June–5 July	15780–15804	Queensland
14–19 Dec.	15865–15908	Victoria, <i>Rubus</i> /Rosaceae with J.R. Hosking & F. Mahr
1999 (438)	15912–	
10–21 Jan.	15914–15966	Tasmania: mostly <i>Rubus</i> and <i>Cotoneaster</i> , with Judy Symon
5–8 Sep.	15973–16011	Eyre Peninsula, Lake Gillies, gypsum, with Judy Symon
20 Sep.	16015–16035	Cooke Plains gypsum
19–25 Oct.	BS104 1805–3722 DES 16043–16050	Biological Survey 104: Flinders Ranges, with P.J. Lang. For report see Brandle (2001)
25 Nov.	BS117 408–460	Biological Survey 117: Southern Mt Lofty Ranges, with D.M. Armstrong. See Armstrong et al. (2003) for report
16–23 Dec.	16054–16063	Mainly <i>Rubus</i> , SA
2000 (443)	16064–	
28 June–1 July	16081–16244	Arckaringa–Cooper Pedy, with Judy Symon
7–11 Oct.	16247–16396	Eyre Peninsula, gypseous sites with Judy Symon
Dec. 2000– Jan. 2001	16483–16493	Mainly <i>Rubus</i> , SA, with Judy Symon
2001 (258)	16490–	
30 Sep.	16515–16543	Craigie Plains Gypsum Site
6–7 Nov.	16548–16689	Gypseous deposits, Yorke Peninsula, with Judy Symon
27 Dec.	16700–16740	Blanchetown area, with Judy Symon
2002 (358)	16750–	
24–27 Apr.	16785–16836	Arckaringa, Oodnadatta area, with Judy Symon
29 Sep.–10 Oct.	16850–17062	Across Nullarbor to Fraser Range, Western Australia, with Judy Symon
2003 (42)	17076–	Includes cultivated <i>Cotoneaster</i> specimens from Mt Lofty Botanic Gardens collected under numbers of R. Hatcher
2004 (19)	17095–	
18–22 May	17101–17111	Kakadu National Park, Northern Territory, with Chris Martine, University of Connecticut
2005 (138)	17118–	
23–28 Aug.	17125–17173	Cooper Pedy
15 Nov.	17180–17249	Overland Corner (MU)
2006 (70)	17250–	
13–19 Sep.	17254–17279	Yorke Peninsula with Millenium Seed Bank (MSB) Partnership
2007 (8)	17290–	
2008 (26)	17301–	
2009 (619)	17315–	
10–12 Jan	17315–17400	Stuart Hwy, observing roadside spread of <i>Solanum</i> and grasses, with Judy Symon
throughout year	CJB and Millenium Seed Bank Partnership (MSB)	Weed collections in Southern Lofty region with Chris Brodie as the main collector, David as advisor. Likewise with MSB collections. These numbers account for the most part for the number of DES collections, as they do in the following years, where again C.J. Brodie is the main collector
2010 (804)	17443–	
4–7 July	17449–17459	Menindee, Broken Hill area, with Judy Symon
2011 (1028)	17717–	
13 Jan.	17697–17725	Adelaide Hills
12 Nov.	CJB 3701–3714	Last field work in Cleland Conservation Park with C.J. Brodie and J. & V. Timbrell

Appendix 2

Publications by D.E. Symon

Publications are sorted by year and author(s), then journal or book title. Publications mentioned in the text are indicated by an asterisk.

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***Calandrinia mirabilis* (Portulacaceae), a spectacular new species from Western Australia with notes on its ecology, seed germination and horticultural potential**

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Abstract

A striking new species, *Calandrinia mirabilis* Chinnock & J.G.West, is described and illustrated and placed in section *Basales* Poelln. It is a little known species from the western part of the Eremaean Province of Western Australia and restricted to the IBRA Gascoyne Bioregion. It is unique among Australian species of the genus possessing large multi-coloured flowers with red-violet petals that abruptly change in the lower third to an irregular white band, then an orange red band then yellow to the base. This species has considerable horticultural potential and notes on its ecology, phenology and seed germination are provided.

Keywords: new species, taxonomy, horticulture, *Calandrinia*, Portulacaceae, Western Australia.

Introduction

This paper describes a new species of *Calandrinia* from Western Australia: *C. mirabilis*. The taxon came to our attention when discovered by one of us (RJC) and recognised as a new species in 1990. Later, a collection made in 1973, held in the State Herbarium of South Australia, was recognised as the same species. Subsequently, several attempts to relocate populations failed until recently, partly due to a number of low rainfall years when ephemeral species would not be present.

The spectacular, large, multicoloured flowers of *C. mirabilis* readily distinguish it from other Australian species. It falls within section *Basales* Poelln. in having 4 stigmas and a 4-valved capsule, but its relationships to other species is not clear. Obbens (2011) compared it with *Calandrinia pentavalvis* Obbens and *C. strophiolata* (F.Muell.) Ewart, B.Rees & B.Wood in sharing a similar petal number ranging from 8–12, but otherwise appeared unrelated. *Calandrinia mirabilis*, like *C. schistorhiza* Morrison, has a basal rosette of flattened, appressed leaves, dilated distally, but the two are not considered closely related. The latter species belongs to sect. *Tuberosae* Poelln., has flowers with 5 petals and thin, wiry, flowering branches with a small, scale-like, papery bract subtending each flower.

The taxonomy and phylogeny of the genus are under investigation by the first author, and it is hoped this work will clarify the placement of *Calandrinia mirabilis*. In recent years, a number of new species have been described from Western Australia (e.g. Obbens 2006, 2011, 2012) and it was considered that the description of

this species was important so that knowledge of it could be disseminated, especially because of its horticultural merit and the current activity being undertaken on the species by various researchers.

Calandrinia mirabilis has great horticultural potential and has attracted a considerable amount of research. Regulation of flowering in *Calandrinia mirabilis* (as *Calandrinia* sp. Mt Clere) has been undertaken by Wahyuni et al. (2010), who looked at day length and growth regulators in the control of vegetative growth and flowering. A series of papers have also been published relating to vernalization and other factors with the aim of manipulating flowering, see Cave & Johnston (2010), Cave et al. (2011), Cave et al. (2013).

***Calandrinia mirabilis* Chinnock & J.G.West, sp. nov.**

Type: Western Australia, Ashburton Botanical District, North of Landor Homestead, 28.viii.2011, R.J.Chinnock 10289 (holo: AD249700; iso: AD249699, AD249701, CANB, MEL, PERTH).

Calandrinia sp. Mt Clere (R.J.Dadd 5). FloraBase, florabase.dpaw.wa.gov.au [accessed: 18.x.2012].

Diagnostic characters: Differs from all other species of Australian *Calandrinia* in having large red violet flowers with white, orange-red and yellow bands in the basal third, and 8–12 petals.

Annual plants, ranging from small flowering individuals 1–3 cm diam. to very large robust plants to 1.2 m diam., initially with a basal rosette (40–) 50–80 (–240) mm diam., of appressed or slightly ascending leaves, which may dry off as flowering branches develop, one or a number of flowering branches radiating from the



Fig. 1. Large population of *Calandrinia mirabilis*, extending to the horizon and growing in mixed *Acacia* shrubland north of Landor (Aug. 2011).

basal rosette, glabrous. *Leaves* alternate, oblanceolate-spathulate, tapering towards base, obtuse, mucronate, fleshy to succulent, basal leaves (20–) 40–90 (–120) mm long, (5–) 10–20 (–25) mm wide, 1.5–2.5 mm thick, margins entire, midrib prominent on undersurface, surfaces similar or lower one slightly paler green. *Inflorescence* a monochasium. *Flowering branches* with green leaf-like oblanceolate bracts 10–80 mm long near base, gradually reducing along branch and becoming linear-acuminate, those subtending pedicels scale-like, translucent, papery, buff-coloured; **smaller plants**: flowering branches spreading to erect consisting of 3–15 flowers; **large plants**: primary flowering branches prostrate to decumbent with secondary inflorescences developing in leafy axils along branch (Fig. 3 & 4), these ascending to erect, 5–7-flowered. *Pedicels* erect to spreading, 15–40 mm long, decreasing in length towards distal end of inflorescence; bracts opposite, lanceolate, acuminate, 4–4.5 mm long with a medial green herbaceous linear band and scarious margins, drying buff-coloured, papery. *Flowers* (20–) 40–70 mm diam., faintly scented, protandrous. *Sepals* ovate, acute, (5.5–) 7–10 (–12) mm long, (4–) 5–8 (–10) mm wide, green, fleshy and with a narrow membranous margin, outside

surface with small rounded papillae, persistent. *Petals* 8–11, oblanceolate-elliptic, broadly acute to obtuse, erose-dentate towards apex, apiculate, 25–35 mm long, 8–11 mm wide, distal 2/3–3/4 red-violet (between RHS 74A and 80A, drying purple-violet RHS 82A), abruptly changing to an irregular white band, then an orange-red band (RHS 45A) then proximally yellow (RHS 6B) to base. *Stamens* more than 50 in 4–5 whorls, extrorse, outer filaments with papillose bases. *Ovary* ovoid, 3–4 mm long; stigmata 4, very rarely 3, 3–5 mm long, free to base; ovules numerous, reniform. *Capsule* ovoid, 4–10 mm long, slightly 4-angled, 4-valved, very rarely 3, dehiscing by an apical pore, pale brown. *Seeds* reniform, 0.6–0.7 mm diam., red-brown, shiny, colliculate, cells laterally elongated. **Plate 1, Fig. 1–3, 5, 6.**

Distribution and Ecology. *Calandrinia mirabilis* extends from the Erong Station east to at least Mt Clere Station in the Pilbara region of Western Australia (Fig. 4). At all sites observed it occurs on red sandy soils on sand plain, but it has also been recorded on dunal rises on gibber plain (R.J.Dadd 5). It occurs in mulga (*Acacia aneura*) low woodlands or in mixed *Acacia* shrublands over mixed annual and perennial grassland where, in a good season, it is abundant and dominates the open



Fig. 2. Plants of *C. mirabilis* were common on road edges along the Landor–Mt Clere road between the Landor turnoff and Waldburg road (Aug. 2011).

areas among grasses. It grows with other species of *Calandrinia*, like *C. creethiae* Morrison and *C. papillata* Syeda, as well as *Eremophila* spp., especially *E. forrestii* F.Muell., *Senna* spp. and *Goodenia* spp. It has also been recorded growing with *Solanum lasiophyllum* Poir. and *Grevillea ?berryana* Ewart & Jean White near Erong.

Like many ephemeral species, the occurrence and size of populations of *Calandrinia mirabilis* are dependent on good rainfall events at the appropriate time of year. When the species was encountered in 1990 by one of us (RJC) it was a relatively dry year and only one small population was discovered on the Waldburg road a few kilometres north of the junction with the Landor–Mt Clere road. The largest plants in this population were about 30 cm diameter although most were 15 cm diameter or less. Flowering stems were all ascending with up to 15 flowers.

In 2009 the area was revisited by one of us (RJC) to search for the species, travelling from Mt Augustus south to Landor and then east along the Landor–Mt Clere road to the turnoff to Waldburg and then north via Waldburg back to Mt Augustus. The area was in drought and no plants of *C. mirabilis* were located. Other species of *Calandrinia* also known to be in the area, as well as

ephemeral genera like *Rhodanthe*, *Waitzia*, *Ptilotus*, *Sal-sola*, *Goodenia* or ephemeral grasses, were also absent.

During autumn–winter 2011, substantial rainfall was experienced throughout the area mentioned above and *Calandrinia mirabilis* was found to be abundant from about 20 km north of Landor Homestead (Fig. 1) south to the Mt Clere turnoff and then almost with a continuous extension east to the Waldburg turnoff. It extended north on the Waldburg road for about 5 km and abruptly vanished where the sandy loams are replaced by stony soils and gibbers. The species was later found on the Meekatharra–Landor road, south of the Dalgety Downs turnoff, and then westwards along the Dalgety Downs road to near the turnoff to Erong.

The species was so abundant that it could be seen at most sites extending to the horizon and it was also very common along the roadsides where some of the largest plants were observed, these obviously benefiting for the additional water run-off (Fig. 2 & 3).

Phenology and Flower development. From the known collections and field observations, the main flowering period probably extends from June to October. The large mature plants found in late August 2011 would certainly have been in flower during July, if not June.



Fig. 3. Large plant of *C. mirabilis*, c. 1 metre diameter, showing primary and secondary branching.



Fig. 4. Distribution map

The species is very uniform in the colour of the flower over its distribution range, although in one population a single individual was discovered with white petals but with the normal colour banding in the basal part of the petal (Fig. 6).

Floral development is protandrous like many of the medium to large flowered *Calandrinia* species. The flower opens late morning day 1. The first anthers have dehisced and at this stage the styles are short, c. 1 mm long, smooth, erect and appressed together. By day 3–4 all anthers have dehisced and usually by day 5 the styles have separated and stigmatic hairs are well developed and receptive. On day 6 the styles have fully elongated to 3–5 mm, lie horizontally, and are covered with long receptive hairs except on the basal half of the abaxial surface (Plate 1D₁–D₃). If pollinated day 5, the flower will close on day 6, but if not pollinated the flower continues to open until day 8.

Conservation status. *Calandrinia mirabilis* (as *Calandrinia* sp. *Mt Clere*) was listed in the Western Australian vascular plant census in 2009 (Western Australian Herbarium 1998–), and subsequently classified by Smith (2010) as Priority 1 under the Department of Environment and Conservation's conservation codes for Western Australian flora. At that time only two collections were held at the Western Australian Herbarium so a Priority 1 classification was appropriate.

Observations by one of us (RJC) on this species in 2011 and 2013, and additional collections subsequently made, suggested that a re-examination of its conservation code was necessary. The conservation status of this species has now been re-evaluated by the Department (M. Smith, pers.comm.) and it is currently listed as

Priority 4 (Rare, near threatened and other taxa in need of monitoring).

Rainfall variation, seed germination and population size.

Calandrinia mirabilis has a restricted distribution in the IBRA Gascoyne Bioregion, extending just over 100 km from east to west and 40 km from north to south. Many ephemeral species like *C. mirabilis* are reliant on a good rainfall before populations will develop. In this particular case, in a dry year the species may be restricted to small populations resulting from localised rain events or absent during very dry years, as was the case in 2009. In 2011 however, following good autumn/winter rainfall, *C. mirabilis* was found to be super-abundant over large areas of its known range while in 2013, an obviously drier year than 2011, populations were more scattered and plants very small.

Like many of the larger flowered arid species of *Calandrinia*, including *C. polyandra* Benth., *C. remota* J.M.Black and *C. reticulata* Syeda, *C. mirabilis* is difficult to germinate from seed. A period of weathering is probably required under in situ conditions and seed may lie dormant in the sandy surface soil layer, tolerating temperatures of 60° C or more over many months for one or a number of years until a rainfall event triggers germination. Temperatures of 64°–67° C have been recorded in Adelaide on a 40° C day at the soil interface with a dark brown (gibber) surface. One can expect similar or higher surface temperatures in the areas *C. mirabilis* occurs during the summer period. One of us (RJC) has managed to maintain this species since 1990, but germination has only followed exposure to sunlight over one or more summers and only very few plants developed. In excess of a thousand seeds were sown of



Fig. 5. Primary branch of *C. mirabilis* with developing (especially in lower part) and fully developed secondary branches with 3–5 flowers.

both the purple and white-flowered forms (*R.J.Chinnock 10294–10295*) in February 2012, but, no germinations had occurred by August 2013, while in an adjacent pan, which had plants sown in years prior to 2012, 13 plants germinated in June/July 2013.

Etymology. The name is taken from the Latin word, *mirabilis*, marvellous, wonderful; referring to the spectacular multi-coloured flowers, a unique feature within the Australian species.

Other specimens examined.

WESTERN AUSTRALIA: 34.4 km S of Waldburg, 3.5 km N of junction with the Lander-Mt Clere road, 18 Sep. 1990, *R.J.Chinnock 8043* (AD, CANB, PERTH); 36 km E on the Lander-Mt Clere road from Lander, 28 Aug. 2011, *R.J.Chinnock 10293* (AD, PERTH); 3.4 km N of turnoff on Lander-Mt Clere road towards Waldburg, 28 Aug. 2011, *R.J.Chinnock 10294* (AD, PERTH); 3.4 km N of turnoff on Lander-Mt Clere road towards Waldburg, 28 Aug. 2011, *R.J.Chinnock 10295* (AD); 26.2 km S of the turnoff to Dalgety Downs on the Meekatharra-Lander road, 13 Sep. 2011, *R.J.Chinnock 10319* (AD, PERTH); 16.7 km W of the turnoff on the Meekatharra-Lander road on the Dalgety Downs road, 13 Sep. 2011, *R.J.Chinnock 10320* (AD, PERTH); 10 km E on the Lander-Mt Clere road from Lander, 18.ix.2013, *R.J.Chinnock 10377* (AD, PERTH); 6 km along Lander-Mt Clere road from Waldburg turnoff towards Lander, 27 July 2006, *R.J.Dadd 5* (PERTH); 21.4 km N along Erong road from turnoff into Erong Springs Station and is also in the vicinity of Macadam Plains, 20 Aug. 2008, *F.Obbens FO22/08* (PERTH); Mountain Well, Mt Clere Station, 29 Sep. 1973, *T.L.Setter 394* (AD).

CULTIVATED: Material based on *R.J.Chinnock 8043* collection: *R.J.Chinnock 9161*, 25 Nov. 1996 (AD); *R.J.Chinnock 9171*, 7 Jan. 1997 (AD).



Fig. 6. *C. mirabilis*, normal flower colour (*R.J.Chinnock 10294*) and the extremely rare white form (*R.J.Chinnock 10295*).

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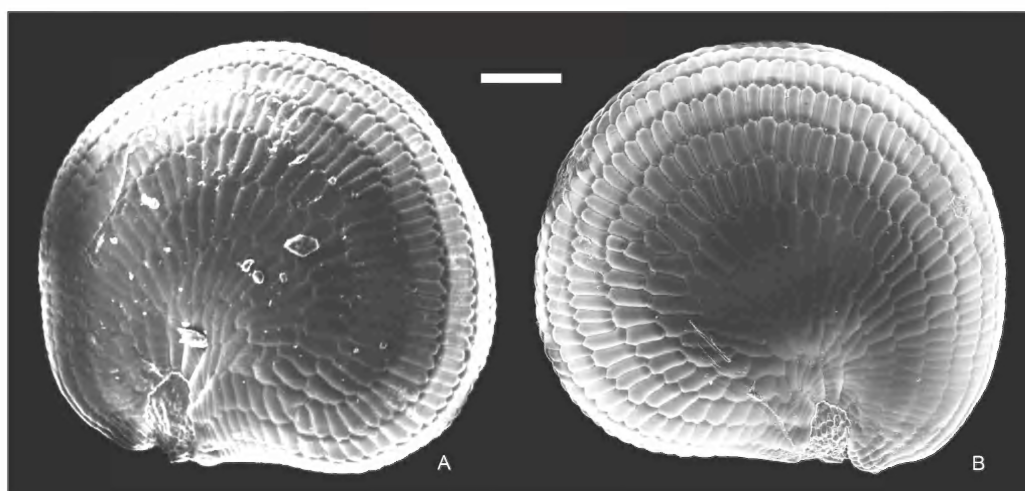


Fig. 6. Photomicrographs of seed from two populations of *Calandrinia mirabilis*. Scalebar: 100 μ m. — **A** R.J.Chinnock 10289; **B** R.J.Chinnock 10295. (Images taken with a Neoscope JCM 5000 SEM).

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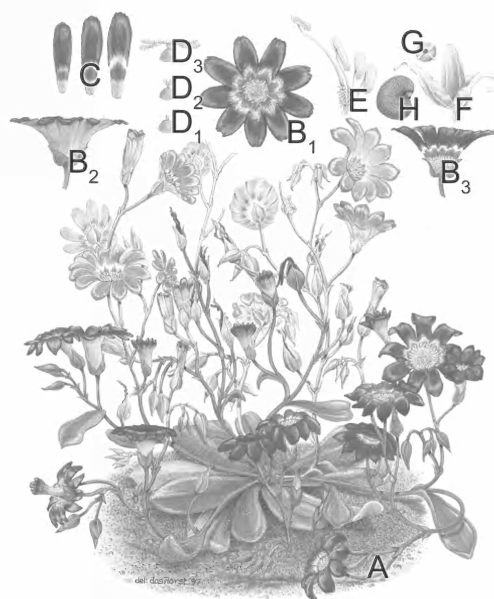


Plate 1. *Calandrinia mirabilis*. Captions for colour plate (opposite page). **A** plant habit; **B** flower: **B**₁ top view; **B**₂ side view; **B**₃ cross-section through flower; **C** petals showing variation in banding; **D** gynoecium: **D**₁–**D**₂ stigmas at anthesis stage appressed together and developing but non-receptive; **D**₃ mature receptive stigmas; **E** stamens; **F** mature capsule, side view; **G** capsule from above showing poral dehiscence; **H** side view of seed. — Illustration by Gilbert R.M. Dashorst, based on cultivated material derived from R.J.Chinnock 8043.

